Joyful Expressions in Infancy: Cross-Species Comparisons

Kirsty Mhairi Ross

November 2010

The thesis is submitted in partial fulfilment of the requirements for the award of the degree of Doctor of Philosophy of the University of Portsmouth.

Abstract

Joyful expressions of one-year-old infants were studied in naturalistic contexts in infants' home environments. Chimpanzee infants (n = 7) and human infants from the Cameroon Nso community (n = 8) were studied in their own right and in comparison. Similar methodologies and the development of a single coding scheme allowed direct comparisons between the groups. The research aims to contribute to knowledge about 1) emotion socialisation; 2) the whole-body expression of emotions in infancy; 3) the evolutionary heritage of emotions; and 4) the functions of joyful emotions.

Playful behaviours were analysed for play type, infant joy (facial, motor, and vocal[1]), play partners and their engagement, and matching of infant joy by play partners. The first study (Chapter 4) describes the play contexts of chimpanzee infants from two settings (Chester Zoo, UK, and Primate Research Institute (PRI), Japan), as there was little published quantitative data specific to one-year-old chimpanzees. Play contexts were similar across settings though the proportion of time spent in the different types of social play varied with more rough-and-tumble play at Chester Zoo (larger group, juveniles present) and more tickling by mothers at PRI. The second study (Chapter 5) describes the joyful expressions of chimpanzee infants. Facial and motor joy occurred at similar rates overall though the rate of facial joy was skewed towards social contact and tickling play to a greater degree than motor joy. Mothers elicited a particularly high rate of infant joy (often during tickling) but peers matched a greater proportion of infant joy (often during contact play). The third study (Chapter 6) describes the joyful

[1] Vocal joy was analysed for human sample only

expressions of human infants. Facial, motor, and vocal joy occurred at similar rates overall though rates of facial joy and vocal joy were skewed towards social communicative and rhythmic play to a greater degree than was motor joy. Play partners matched a greater proportion of infant joy during social communicative and rhythmic play and social object exchange than during other types of social play. The fourth study (Chapter 7) compares the joyful expressions of chimpanzee infants and human infants. The rate of facial joy was equivalent in both groups despite differences in the contexts of play, underlining the importance of joy to infant development in both species. Differences were evident in the rate of motor joy (higher in the human sample) and in matching of infant joy (marginally higher in the human sample, variation by play partners).

The general discussion highlights key findings in relation to the socialisation of joy (e.g. the high rates of joy during play contexts which support social cohesion, the different roles of mothers and peers/older children in eliciting and responding to infant joy) and the whole body expression of joy (the distinctive patterns of facial, motor and vocal joy across social and solitary play contexts). Findings are discussed in relation to theories about the functions of joy.

Contents

List of Tables

List of Figures

Declaration

Whilst registered as a candidate for the above degree, I have not been registered for any other research award. The results and conclusions embodied in this thesis are the work of the named candidate and have not been submitted for any other academic award.

Abbreviations

FACS	Facial Action Coding System
PRI	Primate Research Institute, Kyoto University, Japan
ipm	Intervals per minute

Acknowledgements

I would like to thank Professor Kim Bard, my Director of Studies, for her excellent guidance, support and encouragement and for facilitating access to video records of the Cameroon infants and chimpanzee infants. Her enthusiasm and thought-provoking discussions were invaluable.

The videos of the Cameroon infants were very kindly supplied by Dr. Hiltrud Otto, University of Osnabrueck and Professor Masaki Tomonaga, Primate Research Institute, Kyoto University. Their generosity is much appreciated.

I am also grateful to Chester Zoo for allowing me access to gather my video observations of chimpanzee infants, and to the British parents and children who kindly agreed to be video-taped in their own homes.

The reliability testing of the chimpanzees observations were conducted by Kate Thorsteinsson and Dr. Marina Davila-Ross and I would like to thank them for their time and attention to detail.

The research was funded by a research studentship award from the Economic and Social Research Council.

Dissemination

Bard, K.A., Butler, L., Ross, K., & Keller, H. Socio-emotional contexts of naturally occurring joint attention events in 1-year-old Nso humans and 1-year-old chimpanzee infants. Submitted to SRCD, 31Mar-3 Apr, Montreal, 2011.

Ross, K., Bard, K.A., & Thorsteinsson, K. (2008). The form and context of smiling in infancy across cultures and across species. Abstracts of the meeting of the International Society of Infant Studies, Vancouver, BC, 27-29 March 2008.

Thorsteinsson, K., Ross, K., & Bard, K.A. (2008). Positive emotional expressions in chimpanzee infants. Primate Eye: Primate Society of Great Britain, 96 – Special Issue, 37 (Abstract).

Ross, K. & Bard, K.A. (2007). *Playful expressions and their contexts in one-year-old chimpanzees*. Abstracts of the 2nd Congress of the European Federation for Primatology, held in Prague, Czech Republic, 3-9 Sept 2007.

The following presentations are under my maiden name, Brown:

Brown, K.M., Bard, K.A., Keller, H., Yovsi, R.D., & Otto, H. (2007, August). Joyful emotions in one-year-old British and Cameroonian infants. In K. Bard (Chair), *The first years of life: Broadening our understanding of development by*

taking a cultural models perspective. Symposium conducted at the meeting of the 13th European Conference on Developmental Psychology, Jena, Germany.

Brown, K.M., Bard, K.A., Keller, H., Yovsi, R.D., & Otto, H. (2007, March). *Joyful emotions in infancy: Cross-cultural and cross-species comparisons.* Poster presented at the biennial meeting of the Society for Research in Child Development, Boston, MA.

Brown, K.M., Bard, K.A., Tomonaga, M., Keller, H., & Yovsi, R.D. (2006, July). *The experience of joy in infancy: Cross-cultural and cross-species comparisons.* Poster presented at the 18th International Congress of the International Association for Cross-Cultural Psychology, Isle of Spetses, Greece.

Chapter 1. Introduction and Research Aims

The emotion of joy is one of the basic human emotions. It is the intense burst of happiness we feel when something very good is happening and this feeling is accompanied by smiling, laughter and even jumping for joy. Smiling, the main facial expression of joy, is innate, universal, and has a long evolutionary history. Newborn smile in their sleep and at around 6 weeks old infants begin to produce social smiles during interactions with their mothers, even if they are born blind (Eibl-Eibesfeldt, 1973; Fraiberg, 1974; Plutchik, 1994). People from all around the world smile, regardless of their culture, and there is shared understanding about the meaning of a smile (Ekman & Friesen, 1971; Ekman, Sorenson, & Friesen, 1969). Other mammals have expressions similar to human smiling and laughter, most notably the great apes who display a relaxed open mouth expressions during play and produce quiet breathy laughter when tickled or during rough and tumble play. Joyfulness can occur in many different contexts but it is in young children at play that the expression is probably the most frequent and the most vivid. The following quote, a recollection by the psychologist William Schutz (1967) of his own son, highlights the joyfulness of early childhood:

> When Ethan smiles, every cell of his body smiles, including his turned-up toes. . . And his pleasure now, during his first fifteen months, is mainly physical – being thrown up in the air, sliding off the refrigerator into his father's arm, being tickled and hugged, having his cheeks chewed, his behind munched, his face caressed, rubbing his cheek against another's cheek. . . . He wakes up each morning eager for new adventure. Maybe

> today it will be a piece of string, or the toilet plunger, or the telephone, or pots or pans, or – more rarely a new toy. Ethan is joy. He enjoys each aspect of his life with his whole being. He gives joy to those near him. His joy is contagious. (Schutz, 1967, pp. 9-10).

The emotion of joy is examined in human and chimpanzee infants in this thesis with the aim of understanding more about its function in our lives. In this introductory chapter, I discuss some of the theories and research that influenced my choice of topic. I begin by considering the newly created field of positive psychology which has elevated the importance of understanding joy and other positive emotions. Then, I consider various functional theories of emotions and the place of joy within these theories. Finally, I outline the specific aims of the research studies in this thesis.

A. Positive Psychology and Positive Emotions

Positive psychology was explicitly named as a field of psychology in 1998 by Martin Seligman, then President of the American Psychological Association. The creation of a field of positive psychology was intended to stimulate far greater levels of research into the things that make life worth living, including positive traits, emotions, abilities, achievements and social structures. These topics had been neglected by psychologists in the second half of the 20th century in their desire to understand and treat life's problems (Peterson, 2006).

In the field of emotion research, greater effort has been devoted to the study of negative emotions rather than to positive emotions. This bias reflects a bias that exists in our emotion language such that the English language has many

more words for negative emotions than positive emotions (Kalat & Shiota, 2007). The emotion of joy has received relatively little attention from emotion researchers and it is the topic of far fewer published articles than the emotions of anger and fear. Over the last 50 years, only 44 emotion-related journal articles had joy in the title compared to closer to 900 articles with anger in the title and the same again with fear in the title (PsycInfo database, searched on 1st October 2009).

However, the creation of positive psychology has generated significant interest in positive emotions. Barbara Fredrickson (Fredrickson, 2003; Fredrickson & Branigan, 2005) has been a key figure in raising the profile of positive emotions by asking challenging questions about their functions in our lives and highlighting the need to rethink existing models of emotions, which mainly explain negative emotions (see the next section of this introductory chapter for an outline of her theoretical approach). Popular literature has also been influenced by the ideas of the positive psychology movement (Peterson, 2006). Books on parenting, for example, have traditionally concentrated on the management of negative emotions (such as, crying, temper tantrums, and separation anxiety) through discipline and routine. However, some recent books are promoting the role of fun, playfulness and laughter in building good parent-child relationships, in fostering positive behaviours, and in developing creativity. Two such books are *Playful Parenting* by Lawrence J. Cohen's (2001) and *The Power of Play: Learning What Comes Naturally* by David Elkind (2007).

Although there is a great deal of interest in positive emotions, specific studies of joyful emotions remain relatively uncommon. A review of the literature is complicated by the lack of distinction between joy and happiness in some

studies. While there is a considerable amount of research on the correlates of happiness and general positive moods (for reviews of happiness research see Argyle, 2001; Isen, 2004; Peterson, 2006), less attention has been given to the brief moments of joy signified by smiling and laughter.

It is important to deal with their similarities and differences between joy and happiness at this point. In the English language, joy and happiness are synonyms and empirical studies of emotion language confirm the significant overlap in their meanings in everyday use (Shaver, Schwartz, Kirson, & O'Connor, 1987). However, the meanings of joy and happiness are relatively vague and cover a variety of pleasurable states and feelings. The word 'happy', in particular, is a very frequently used word and can be used in diverse contexts such as intense excitement, quiet contentment, life satisfaction, and personality (Wierzbicka, 1999). For scientific clarity, emotion researchers have had to apply stricter definitions of joy and happiness than those in common usage. In recent years, the word 'happiness' is applied to positive moods or personality traits whereas the word 'joy' has typically been used to refer to the emotion. An emotion is defined as an immediate and brief response to events with each emotion being distinguished by its typical antecedent events, cognitive appraisals, behavioural responses and action tendencies (Kalat & Shiota, 2007; Keltner & Gross, 1999; Niedenthal, Krauth-Gruber, & Ric, 2006; Planalp, 1999). The prototypical definition of joy was identified in a large scale study which asked adult participants to write about their emotional experiences (Shaver, Schwartz, Kirson, & O'Connor, 1987). Joy was found to occur in events involving achievement or affection; it was evident in smiling, laughter, bounciness and liveliness; and it encouraged sharing of the emotion and friendly behaviours. In

contrast to joy, happiness is a more long lasting feeling than an emotion, with a less obvious onset and with less obvious outward expressions (Parkinson, Totterdell, Briner, & Reynolds, 1996). Happiness is influenced by judgements about the frequency and intensity of joyful experiences as well as judgements about life satisfaction (Argyle, 2001). This thesis solely explores the emotion of joy, as observed through events, behavioural expressions and their consequences.

To conclude this section, it was positive psychology that sparked my interest in studying the good experiences in life and positive emotions in particular. My background in developmental psychology as a Masters student focused my attention on joyful emotions in infancy. There has been considerable theoretical debate in recent years about the functions of positive emotions such as joy and some of these theories are introduced in the next section.

B. Theories about the Function of Joy

Joy is regarded as a basic emotion,[2] as are the emotions of anger, fear, and sadness. The term basic is used to convey that an emotion is universal within the human species, emerges in early development, has distinctive expressions, and that it has specific functional benefits (Ekman, 1999b; Kalat & Shiota, 2007; Niedenthal, Krauth-Gruber, & Ric, 2006). Empirical evidence based on facial expression research shows that the smiles of joy are universally understood (Ekman & Friesen, 1971; Ekman, Sorenson, & Friesen, 1969) , emerge within the

[2] Ekman, in his early work on basic emotions, used the term happiness rather than joy to label the emotion distinguished by smiling expressions (Ekman & Friesen, 1971; Ekman, Sorenson, & Friesen, 1969) However, more recently he has expressed dissatisfaction with the vagueness of the terms happiness and joy and proposes that there may be several enjoyable emotions (Ekman, 2003). Recent emotion textbooks refer to the basic emotion as joy rather than happiness (Kalat & Shiota, 2007; Niedenthal, Krauth-Gruber, & Ric, 2006)

first few weeks of life (Wolff, 1987), and are also distinctive from other emotional expressions from an early age (Oster, 2003; Oster, Hegley, & Nagel, 1992). However, the functional benefits of joy are less clear.

Joy and the other basic emotions are believed to have a long evolutionary history and have been encoded in our genes to some degree because their fundamental function is to facilitate survival. Charles Darwin (1809-1882) was the forerunner of the modern evolutionary approach to the function of emotions. In his book, *The Expression of the Emotions in Man and Animals* (Darwin, 1872/1999) Darwin noted similarities of emotional expression across the animal kingdom with particularly close similarities between the emotional expressions of monkeys and apes and those of humans. In the case of joyful emotions, he noted that:

> We may confidently believe that laughter, as a sign of pleasure or enjoyment, was practised by our progenitors long before they deserved to be called human; for very many kinds of monkeys, when pleased, utter a reiterated sound, clearly analogous to our laughter, often accompanied by vibratory movements of their jaws or lips, with the corners of their mouth drawn backwards and upwards, by the wrinkling of the cheeks, and even by the brightening of the eyes. (Darwin, 1872/1999, p. 356)

Darwin further supported his ideas of innate emotions by gathering anecdotal evidence that human emotions were the same across diverse cultures . According to Darwin, emotional expressions were likely to have evolved from movements that had a direct use to our distant ancestors. For example, bared teeth before an attack evolved into an expression of anger that was unlikely to result in an actual attack. Darwin believed that emotional expressions had evolved to

communicate states of mind and that this was beneficial to our survival and reproductive ability. However, he did not develop his ideas about precisely how emotions facilitated survival.

Modern functional theories differ greatly in their explanations of how emotions function to facilitate survival. In this section, I discuss several perspectives on the functions of emotion; 1) an organisational function; 2) a resource building function; 3) a communicative function; and 4) a socio-cultural function. Each perspective is considered in relation to joy and positive emotions in general.

B.1. An Organisational Function for Emotions

Theories which propose an organisational function of emotions are based on observations that certain emotions seem to lead to predictable behaviours or behavioural urges, for example when fearful we want to run and when angry we want to attack. Emotions are often considered to be "immediate reactions to events that are sensed often unconsciously to be very important to our welfare for better or worse" (Ekman, 2003, p. 19). Therefore, several theorists have proposed that when faced with such events emotions function to quickly organise our response by coordinating cognition, physiology and behaviour (Cosmides & Tooby, 2000; Ekman, 1999b; Oatley & Johnson-Laird, 1987). At one level, these organisational responses may be genetically coded programs that have evolved through the repeated recurrence of certain challenges and opportunities that are fundamental to life. At another level, organised responses may develop

throughout an individual's life. Ekman acknowledges that any organisational function is likely to work at both levels:

> . . . something important is happening inside the person who shows the emotion. Those internal changes are preparing the person to deal quickly with an important event, more often some interpersonal encounter, in a way that has been adaptive in the past. The past refers to our past as individuals, and what has been adaptive in the history of our species. (Ekman, 1999a, p. 372).

If emotions do play an organisational role then the basic emotions would be expected to activate distinct emotional systems in the brain. There is some evidence for basic emotional operating systems based upon the observed behavioural consequences of localised electrical stimulation of the subcortical regions of mammalian brains. Seven basic emotional systems (seeking, fear, rage, lust, care, panic, and play) have been discussed by Panksepp and Smith-Pasqualini (2005). They hypothesise that each system can be related to certain emotions and emotional disorders e.g. the emotional system for play is likely to relate to the emotion of joy and manic emotional disorders (for further reading see Panksepp, 2000a, 2000b; Panksepp, 2004; Panksepp & Smith-Pasqualini, 2005).

Much of the rationale for an organisational function has been based on negative emotions, and positive emotions seem to be a poorer fit with the theory. In the cases of anger and fear it is easy to see the value of an instinctive, organised response that facilitates our immediate survival. Physiologically, fear and anger stimulate the fight or flight response of the adrenal system which quickly prepares the body to take appropriate action. It is less obvious to see how positive emotions promote thoughts, actions and behaviours that are of immediate

benefit to survival especially as no clear physiological response patterns are evident (Fredrickson, 2003). Indeed, Ekman (2003), a strong proponent for the organisational function of emotions has difficulty applying an organisational function to joy. Instead, he suggests a vaguer motivational function for joy which encourages activities essential for survival, such as sexual relations and parenting. A more popular theory is that positive emotions have a resource building function as discussed below.

B.2. A Resource Building Function for Positive Emotions

Positive emotions seem to broaden our thoughts and behaviours thus opening us up to new experiences (e.g. Fredrickson, 2003; Fredrickson & Branigan, 2005; Tomkins, 2008). In contrast, negative emotions seem to narrow our thinking and quickly organise a response to help us cope with a difficult situation. By expanding the possibilities open to us, positive emotions facilitate the development of a variety of personal abilities which may be of indirect benefit to our survival by helping us to deal with challenging situations in the future. Fredrickson (2003) has been an influential proponent of this theory and has named it the *broaden-and-build theory* for positive emotions such that "positive emotions broaden an individual's momentary mindset, and by doing so help to build enduring personal resources" (p. 332). Fredrickson does not go into detail about the specific effects of different positive emotions. However there is reference to the role of joyful emotions in promoting and sustaining childhood play which builds physical, intellectual, psychological and social resources. There is significant overlap here with theories about childhood play and its function in

developing social skills and physical skills that will be beneficial in adulthood (Barnett, 1998; Fagen, 1981, 1984; Power, 2000).

Evidence for the thought broadening effect of different positive emotions was gathered in a couple of experiments by Fredrickson and Branigan (2005). Short film clips were shown to adult participants to induce emotional states of amusement, contentment, anger, anxiety or no particular emotion. Afterwards, those in an amused or contented state showed more global processing in a visual task and generated more thoughts and actions in imagery task than those in any other state. Directionally, those who were amused performed better than those who were contented. Other indirect evidence comes from studies of the positive moods and happiness. Generally, those induced to feel positive have more creative and flexible approaches to problem solving and integrate diverse information better (for a review of studies see Isen, 2004). Furthermore, happy people have been shown to be more sociable, more cooperative, more successful in relationships, more altruistic, more effective at work, and healthier (for a review see Argyle, 2001). Evidence for the resource building function of positive emotions is limited and difficult to collect as it requires detailed longitudinal studies.

B.3. A Social Communicative Function for Emotional Expressions

Theories about a social communicative function for emotions focus on emotional expressions whereas the two functional theories already introduced dealt with emotion in broader terms. Social communicative theories propose that expressions such as smiling and laughing communicate information which is

useful in social situations. However, there is disagreement about the extent to which this information conveys emotional states rather than other socially useful information.

According to an emotional view of expressions, expressions communicate a person's emotional state (Darwin, 1872/1999; Ekman, 1994, 1999b, 1999c; Ekman & Friesen, 1982; Izard, 1997). Communication of emotional states is thought to be beneficial to an individual because the information will influence the behaviour of others towards them. Only certain prototypical expressions are thought to be spontaneous expressions of an individual's true emotional state while other similar expressions may be used deceptively to convey the impression of a particular state. The existence of different types of smiles is often used to support this idea. The Duchenne smile is thought to be a true expression of joyfulness and involves raising of the lip corners, contraction of the cheeks, and wrinkling of the eyes. In contrast, the non-Duchenne smile, involving only lip corner raising, is sometimes regarded as a false smile used to convey the impression of joyful emotions when this impression would have beneficial social consequences (Ekman & Friesen, 1978). However, the existence of different types of smiles may also be reflective of different levels of enjoyment or even different types of positive emotions as suggested by studies of infant smiling. Infant smiles have been observed to vary by context with Duchenne smiling found during play with a smiling mother (Messinger, Fogel, & Dickson, 2001); Duchenne smiling with an open mouth found during physical play with fathers (Dickson, Walker, & Fogel, 1997); and non-Duchenne smiles found when gazing at mothers prior to and after play (Fogel, Nelson-Goens, Hsu, & Shapiro, 2000) and when greeting strangers (Fox & Davidson, 1988). Facial expression coding is enabling fine-

grained analysis of emotional expressions that will help to further understand how subtle variations of emotional expressions are being used across different contexts.

One perspective is that facial expressions function purely as social tools and communicate a range of information that is not necessarily related to emotional states. Emotional states may just be a small part of the information that is being conveyed by expressions and other information may also be communicated such as the person's cognitive state, current situation, attitudes, and likely actions (Russell, Bachorowski, & Fernandez-Dols, 2003). Indeed, it is not even necessary to assume that expressions correspond to discrete emotional states and some suggest it may be simpler to regard expressions as messages which function to influence others behaviour (Fridlund, 1997). Regardless of whether or not emotions are part of the message conveyed by expressions, expressions and the vigilance of others towards them are believed to have evolved because they allow the reliable prediction of future actions. According to this perspective, expressions can only be fully understood by considering the context. For example, a smile may communicate a general intention to be friendly and depending on the context this could be interpreted as a readiness to play or a readiness to appease. The idea of facial expressions as messages rather than indicators of emotional states is prevalent in animal studies because of a desire to avoid accusations of anthropomorphism.

The role of emotional expressions in communication between preverbal infants and their mothers has been of considerable interest to psychologists. Again there is a debate over whether emotional states are being communicated or if expressions are simply tools that the infant uses to get caregiver attention. The co-

occurrence of emotional feelings with emotional expressions is difficult to measure with adults and especially so with infants who cannot verbalise their feelings. Therefore, some researchers focus purely on how the expressions are functioning as social tools. Crying prompts the caregiver to attend to basic needs such as feeding, cleaning, and comfort whereas smiling and laughter encourage the caregiver to engage in playful activities (Fridlund, 1997). Despite the difficulties in measuring emotions many believe that the communication of emotional states is a key feature of infancy because it helps to create strong emotional bonds with caregivers. Such emotional bonds are thought to be particularly vital to survival in human and other primate species where the young have a long period of dependency (Izard & Ackerman, 2000).

In this thesis, I will refer to expressions as emotional despite the disagreement about what is actually being expressed. I do so because in everyday usage the expressions of smiling and laughter are inextricably linked to joy and happiness and so it seems reasonable to assume that at least some of the information conveyed by these expressions is emotional.

Theories about the function of one particular expression, laughter, have been the subject of much recent attention. Laughter is a particularly interesting expression because it has both facial and vocal elements. Social communicative theories in general have been heavily based on explaining the function of facial expressions but vocal expressions may have unique features. In an attempt to formulate functional explanations of laughter, there have been several reviews of the literature which consider evidence from biology, cognition, development, communication and play behaviour (e.g. Caron, 2002; Gervais & Wilson, 2005; Owren & Bachorowski, 2003; Provine, 2000; Weisfeld, 1993). In general these

reviews conclude that laughter evolved in our primate ancestors as a means to promote play, though in modern humans it has developed several different forms and functions. There are two main perspectives on how laughter functions to promote play. One perspective treats laughter as a signal of playful intent which is used to initiate and maintain play (Caron, 2002; Weisfeld, 1993). For example, the laughter that often occurs during the tickling and rough and tumble play of young monkeys, apes and humans may function as a reassurance between play mates that the intention is playful rather than aggressive. Thus, youngsters are able to practise self-defence and attack in a safe context. Facial expressions could not function as effective signals in this situation as they would not always be visible. An alternative perspective is that laughter promotes play by being contagious such that laughter induces a joyful emotional state in others (Gervais & Wilson, 2005; Owren & Bachorowski, 2003; Provine, 2000). The contagious effect of laughter allows emotions to be shared without the conscious effort required in interpreting laughter as a signal. Gervais and Wilson (2005) emphasise the benefits of laughter to the group rather than to any individual. They suggest that laughter and its contagious effects evolved in the common primate ancestors of humans and great apes as a way of rapidly spreading playfulness throughout a social group during brief periods of safety and satiation. The social play that resulted from laughter would have improved group functioning and cohesion. It is possible that laughter may have emerged long before our primate ancestors in other highly social species. For example, rats exhibit a high frequency laughter-type chirping response to tickling (Panksepp, 2000b). Both of these perspectives suggest that laughter promotes play which in turn develops skills which improve the chances of individual or group survival. Therefore,

social communicative theories about the function of laughter overlap considerably with the broaden-and-build function of positive emotions described earlier.

Theories about the function of laughter acknowledge that laughter in modern humans has a much wider range of forms and contexts than it would have had in our primate ancestors and possibly many different functions. For example, we laugh at incongruity and jokes and we laugh when nervous or when trying to appease others (Caron, 2002). We also use laughter to punctuate our speech (Provine, 2000). The diversity of human laughter is likely to have evolved in conjunction with language and increasingly complex play behaviour such as art and comedy (Caron, 2002).

B.4. A Socio-Cultural Function for Emotions

There is considerable variation across cultures in the contexts of emotions and their interpretations despite the similarity in form of certain basic emotional expressions such as smiling. Those who take a social constructionist perspective on emotions believe that culture and social relationships are intrinsic to the creation of most aspects of emotional experience, including feelings, contexts, language, and interpretations of meaning (Averill, 1980; Harre, 1986; Harre & Parrott, 1996). From this perspective emotions ultimately function to support the functioning of social groups and the promotion of cultural values (Keltner & Haidt, 1999). Proponents of an organisational function of emotions allow for the influence of culture to a much lesser extent such that we learn to apply certain cultural rules about how and when emotions should be displayed (Keltner &

Ekman, 2000). Culture clearly interacts with emotions, even though the extent of this interaction is debatable.

Historically, there have been many anecdotal reports of cultural differences from anthropologists and psychologists. In relation to joy, there have been descriptions of joyful expressions occurring in response to events that Western cultures would regard as undesirable. For example, the Japanese wives of Samurai warriors were reported to smile when they learned that their husbands had died in battle and some Chinese cultures were reported to clap their hands when worried or disappointed (Kalat & Shiota, 2007). Other anecdotal evidence refers to differences in the frequency of smiling. Americans seem to smile particularly frequently, even during brief interactions, whereas Poles appear much more serious. It seems to be important to Americans to project an impression of happiness whereas Poles strongly dislike any falseness or insincere smiles (Wierzbicka, 1999). Studies of emotion language have also revealed words for specific types of joy that have no equivalent in the English language. Some examples are *schadenfreude* (German), joy in the misfortune of rivals; *fiero* (Italian), joy in personal accomplishment; *naches* (Yiddish), joy from your child's accomplishment; and *amae* (Japanese), joy in being dependent on another person (Ekman, 2003). However, it remains unclear about how these language differences relate to the actual experience of emotion in different studies.

In recent years, there has been considerable interest in measuring cultural differences in emotional experiences and emotional expressions, particularly through self-reports and experimental studies. One study by Scherer and colleagues (Scherer, Wallbott, Matsumoto, & Kudoh, 1988) asked participants from several countries about the contexts in which they experienced emotions and

there was considerable variability The emotion of joy was strongly associated with achievement in the United States, while in Japan joy was more strongly associated with relationships. This finding fits with the positions of these cultures on the dimension of individualism versus collectivism: the United States is a highly individualist culture while Japan is a highly collective culture. Differences between the way Americans and the Japanese express and interpret emotion have also been studied experimentally. In one study by Masuda et al. (2008), Japanese and American participants rated the emotional intensity of a central figure in a crowd and the ratings of the Japanese participants, but not the American participants, were influenced by the emotional expressions of the crowd. Therefore, this study supports the idea that collectivist cultures pay more attention to the social context when they interpret emotions.

The process by which the social and cultural environment influences emotional expression is called emotion socialisation (Planalp, 1999). Emotion socialisation takes place from birth onwards mainly through interactions with parents. Infants learn about emotions by observing their parents expressions of emotion, by observing their parents reactions to their own emotional expressions, and, as speech develops, they also learn by talking about emotions (Eisenberg, Cumberland, & Spinrad, 1998; Saarni, 2000). Furthermore, the activities which parents' make available to their children expose them to certain emotions and parents' emotional reactions to their children communicate their expectations about how emotions should be felt and expressed. These emotional expectations will be influenced by the personal life histories of the parents as well as wider cultural values (Fredrickson, 1998).

B.5. The Possibility of Multiple Functions of Joy

To conclude this section, it seems that all the theories - organisational, resource building, social communicative, and socio-cultural – can add something to the understanding of joy. These theories approach the issue of function from different levels, and joy is likely to have multiple functions. According to Keltner and Haidt (1999), it is helpful to consider emotion functions at four levels of analysis - intra-individual, dyadic relationships, small groups and culture. The organisational and resource building theories approach the issue of function in terms of benefits to the individual and their survival while the social communicative theories consider the functional benefits of emotional expressions in dyadic relationships and small groups. All of these theories have a strong interest in the evolutionary origins of the functions of emotions. In contrast, the socio-cultural theories are less concerned with evolutionary origins and focus instead on the potential flexibility of emotions to support cultural frameworks. Individual research studies cannot begin to provide definitive answers on the function of emotions but they can make valuable contributions to the debate by learning more about the richness of emotional experience in natural contexts.

C. Research Aims

In this thesis, I study the joyful expressions of one-year-old infants. One-year-olds emerging locomotor and social skills open them up to a diverse range of play opportunities and play is a rich source of joyful expressions. The first study looks at play and joyful expression in chimpanzee infants (Chapters 4 and 5) and the second study looks at play and joyful expressions in infants from a rural

Cameroon community (Chapter 6). Comparisons between the two groups are made in the third study (Chapter 7). The methodology and coding scheme (Chapters 2 and 3) were developed to allow direct comparison between human and primate research groups. The specific aims are detailed below.

1. To contribute to knowledge of emotion socialisation by studying the naturalistic contexts of infants' joyful expression and the responses of significant others.
2. To contribute to knowledge about the whole-body expression of emotions by considering facial, motor, and vocal modes of joyful expression in infancy.
3. To contribute to knowledge about the evolutionary heritage of joyful emotions, as well as species specific differences, by comparing joy in human and chimpanzee infants.
4. To contribute to the development of theory about the functions of joyful emotional expressions in early development.

Chapter 2. Methodological Approach

The specific aims of the research were to describe and compare the ways that infants from different cultures and primate species express joy, and to explore how socialisation influences the contexts of joyful expression. A cross-cultural and cross-species approach was applied to naturalistic observations of one-year-olds to capture the richness of joyful expression in everyday contexts. A single coding scheme was developed to allow direct comparison of quantitative data across the groups. This chapter outlines the ethological approach and discusses some naturalistic studies of joyful expression which have influenced the methodological approach in this thesis. The rationale for the selection of the research groups is discussed. The chapter concludes with a description of the coding scheme, discussion of its development, and the rationale behind the levels of analysis.

A. An Ethological Approach

Joyful expressions in chimpanzee and human infancy are studied with an ethological approach in this thesis. This approach can be defined as "the naturalistic study of behaviour from an evolutionary perspective" (Burghardt, 2006, p. 10). Detailed objective descriptions of behaviour are the fundamental characteristic of such research. These observations can be used to inform theory building and subsequently may be followed by the design of experiments to test specific hypotheses (Martin & Bateson, 2007). The ethological approach was

developed in the mid 20th century by the Austrian zoologist Konrad Lorenz (1903–1989) and the Dutch biologist Nikolaas Tinbergen (1907 – 1988) who conducted observational studies of animal to explore instinctive behaviour patterns (Burkhardt Jr, 2005). The ethological approach was transferred to human subjects by Irenaus Eibl-Eibesfeldt from the mid-sixties onwards. He initially used an ethological approach to study animal behaviour but then began to use the same approach to study the expressive behaviours of those born deaf and blind (Eibl-Eibesfeldt, 1973) and to document the everyday life of remote cultural groups (Eibl-Eibesfeldt, 2007).

Ethological studies have to be very selective about the behaviours and contexts chosen for observation and analysis otherwise the task would quickly become unmanageable. In relation to joyful expressions in infancy, previous ethological studies have focused on areas including the rates of smiling and laughter during human infants' mastery of new motor skills (Mayes & Zigler, 1992); the rates of smiling and laughter during wild chimpanzee infants' object play (Ramsey & McGrew, 2005); and morphological differences in the smiles of human infants across various types of play in the home environment (Dickson, Walker, & Fogel, 1997). However, joyful expressions have often not been a central topic in ethnographic research but have instead been studied as a small part of broader research into emotional expressions and communication, both in human infancy (e.g. Kokkinaki, 2003; Lamb, 1977; Rubenstein & Howes, 1979) and in chimpanzee infancy (e.g. Bard, in prep; Flack, Jeannotte, & De Waal, 2004; Plooij, 1979; van Lawick-Goodall, 1968; Waller & Dunbar, 2005). Recent research into infant smiling has been has been dominated by interest in the morphology of smiles and the different patterns of muscular activation that arise

in different types of interaction and contexts. Typically, this research is laboratory based to facilitate the close-up video-recording of faces. Observation periods are short because coding muscular activation is very time intensive. Sometimes, participants are simply asked to play (e.g. Messinger, Fogel, & Dickson, 1999; Messinger, Fogel, & Dickson, 2001) and sometimes experimental manipulations are involved (e.g. Camras et al., 1998; Fogel, Hsu, Shapiro, Nelson-Goens, & Secrist, 2006). A laboratory-based approach can work well when the focus is on expressions in early infancy during face to face play with mothers or during object play. However, it is more difficult to study the relationship between joyful expression and the wide range of activities that are available to older and more mobile infants. This thesis aims to broaden the perspective on infant smiling by observing the everyday contexts of infant smiling across a range of play types and play partners. The focus is on detailed analysis of the observations. This aim is in contrast to previous ethological studies of infant smiling which have tended to observe and experimentally manipulate a narrow range of contexts. Furthermore, the cross-species comparison, using the same units of analysis, of human infants from the Cameroon Nso community and chimpanzee infants, adds a unique aspect to this research.

The four general questions that should be asked of all behavioural patterns identified through ethological studies were set out by Tinbergen in the 1960s: 1) the factors that cause or control the behaviour; 2) the development of the behaviour over the life-span and the consequences of environmental events on development; 3) the evolutionary origins of the behaviour; and 4) the adaptive value of the behaviour (Burkhardt Jr, 2005). Further questions regarding the emotional and cognitive aspects of behaviour are becoming increasingly relevant

to modern ethologists (Bekoff, 2006, 2007; Burghardt, 2006). Behavioural researchers, for much of the 20th century, disregarded emotional and cognitive experiences as being too subjective to be submitted to scientific study. However, in the last twenty years or so there have been advances in understanding the links between emotion, cognition, and behaviour and so these issues are pertinent to ethologists if still somewhat controversial. Tinbergen's original questions and the question of the emotions underlying expressive behaviours are relevant to the research in this thesis. The influence of the playful context on causing or stimulating joyful expression will be examined and the rate of joyful expression will be compared across a range of play types and partners. The research will contribute to knowledge about the developmental path of joyful expression by providing a detailed study of joyful expression in one-year-olds and comparisons can be drawn with existing literature on other ages. The evolutionary origins of joyful expression can be considered by exploring the similarities and differences in the contexts of joyful expression in two primate species, humans and chimpanzees, who share a common ancestor. The adaptive function of joyful expression can be considered by discussing how the results relate to existing knowledge about the culture and social structures of the human and chimpanzee groups. On the final question regarding the emotional experience underlying behaviour, the research considers the multi-modal expression of joy – facial, motoric and vocal – and the role of these expressions in communication.

B. Naturalistic Observation

The method of naturalistic observation was employed in this thesis in line with the overall ethological approach and with the aim of achieving a high degree of ecological validity. One-year-old infants were video-taped in their everyday environments using the focal sampling technique (Altmann, 1974) and then the video-taped observations were micro-analysed using a coding scheme. The development and detail of this coding scheme is described in Chapter 3. The coding scheme allows the observations to be objectively described and categorised, firstly for each research group in their own right (Chimpanzees: Chapters 4 and 5, Cameroon Nso: Chapter 6) and secondly for the purposes of cross-species comparisons (Chapter 7). The detailed descriptions and analysis permitted by the coding scheme will allow theories to be developed about how joyful expressions are socialised to support the development of infants to become successful members of the group.

Studies involving naturalistic observation seek to minimise the effect of observers on the behaviour of their subjects. In this research, as is often the case, this was easier to achieve with the non-human subjects than with the human subjects. For the chimpanzee subjects, the videotaper had very little effect, if any, on chimpanzee behaviours. Observations took place from outside the enclosures and there was no indication on the videotapes that the infant chimpanzees, their mothers or any other group members noticed the video-camera or tried to interact with the video-taper. The chimpanzees studied were habituated to observations by members of the public and by researchers. In the case of the human subjects from the Cameroon Nso community, the infants, their mothers and other members of

the family and village had consented to take part in a study of child development in which they would be video-taped at prearranged times. Being videotaped was a relatively unusual event and efforts were made to minimise the strangeness of the situation by employing an individual from the wider community as the video-taper (recruited by Hiltrud Otto from University of Osnabrueck who was conducting fieldwork in the community and had become a familiar face). The Cameroon Nso subjects were asked to continue with their everyday activities and neither the subjects nor the videotaper were aware of the specific research interest in joyful expressions. However, observer effects cannot be ruled out completely. On rare occasions, there were brief interactions between the video-taper and infant and between the video-taper and other individuals surrounding the infant. Regardless, there was little indication that the expressions and contexts of joy in the human sample were adversely affected and certainly not to any greater extent than similar observational studies.

The research took a non-manipulative approach so that joyful expressions could be observed arising naturally across a range of everyday contexts. No toys or other stimuli were provided by the researchers and there was no alteration to the subjects' normal environments. Subjects were free to move about as normal, feed as normal, and interact with whoever and whatever they wished. Importantly, no instructions were given to the subjects, other than asking the Cameroon Nso mothers to continue with their normal daily activities. This meant that a great variety of activities were observed during sessions lasting at least 20 minutes at a time with a total of at least one hour per infant. The methodology allowed for joyful behaviour to be observed in social and solitary activities. Joyful expression has been observed in young children during solitary play (Bainum, Lounsbury, &

Pollio, 1984) but it has been a neglected area of research. Other naturalistic studies of infant joyful expression in the home environment have often involved some manipulation of the context by specifying who the infant should be interacting with at each session and by instructing mothers and other caregivers to play with the infant (e.g. Adamson & Bakeman, 1985; Dickson, Walker, & Fogel, 1997). It may not be justifiable to generalise from short-term observations of joyful expression during organised play sessions to the expressions of joy that arise naturally throughout the day. Landau (1977) found that the set-up of the observation sessions did affect infant and mother smiling behaviour in the four Israeli environments they selected to study. First they collected several hours of observation where mothers were asked to act normally with their infants and there were group differences in the rate of infant smiling. Subsequently, they asked each mother to attempt to elicit smiles from her infant in an observation session lasting a few minutes. In these latter sessions, group differences in rate of infant smiling disappeared while group differences emerged in mothers' smile eliciting behaviours. The non-manipulative approach in this research supports the aim of understanding whole-day joyful behaviour as infants interacts within their natural surroundings (i.e., as a function of socialisation culture).

Although the observations reported in this thesis were non-manipulative, some selection of contexts occurred due to certain restrictions regarding the availability of subjects. The chimpanzees were only videotaped during the daytime in their daytime enclosures because their night-time accommodation was out of public view. The Cameroon Nso participants decided with the local research team on mutually convenient observation times during the day and the early evening when mothers would be in the vicinity of their infants. As a result,

there were no observations at mealtimes and adult male relatives were rarely around the home. These restrictions are not thought to have affected the specific variables under study to any greater extent than found in many other studies of infants.

C. Selection of Research Groups

C.1. Chimpanzee Samples

A major goal of this thesis was to compare infants across closely related primate species, and humans and chimpanzees were chosen as the comparison groups for numerous reasons. Chimpanzees are demonstrably the closest living relatives of humans (Diamond, 1993); they express joy or playfulness with well known facial and bodily expressions (Plooij, 1979; van Hooff, 1972; van Lawick-Goodall, 1972); and they are the most widely studied of the great apes with several long-term field research sites (e.g. Gombe Stream Research Center; Mahale Mountains Chimpanzee Research Project), laboratory-based research centres (e.g. Living Links, Emory University; Primate Research Institute, Kyoto University) and many zoo-based research studies. Furthermore, videotapes of a small group of one-year-old chimpanzees (n=3) were already available as a result of a collaboration established by Bard, my Director of Studies, with Matsuzawa, Director of the Primate Research Institute of Kyoto University. Since this was a small number of infants, I decided to collect additional observations of infants from Chester Zoo in England (n=4). This resulted in a larger sample of one-year-old chimpanzee infants from two well-established groups of chimpanzees.

The chimpanzee infants were observed in captivity and the conclusions drawn from this research need to take the context into account before generalising the results to the species. Animal ethologists often have a strong preference for conducting naturalistic observation in the wild rather than in captivity as the observations provide the foundation for valid conclusions about characteristics that are typical of the species (thus, studies in the wild have high external validity). However, studies of wild chimpanzees are very time-, and labour-intensive, and often result in very small samples in infancy research. For example, in one of the few studies of joyful expressions in wild chimpanzees, five infant and juvenile subjects in Gombe, Tanzania, were each tracked and observed for several months in order to collect sufficient data to analyse the rate of smiling and laughter during object-related activities (Ramsey & McGrew, 2005). Observations of captive chimpanzees have the benefit of being easier and quicker to collect, and they make possible more detailed analysis than is often the case on observations taken in the wild. Nevertheless, studies of captive chimpanzees could have lower external validity than with wild populations, given that captive and wild settings vary along several dimensions which could affect behaviours. Variations include the type and availability of food; the time budgets of activities (e.g. the ready availability of food in captive settings may free more time for non-foraging activities, De Waal, 2003); the stability of the social group composition (stronger relationships may develop in captive settings compared to the wild where there is more fission-fusion and other movements between groups, such as female transfers at adolescence, Goodall, 1986); and the stability of the environment, which may result in some boredom and less exploration in captive settings. Differences are not just apparent between wild and captive chimpanzees

but also exist between groups of wild chimpanzees who are differentially affected by issues such as human encroachment on the forest and food availability. Furthermore, there is evidence for cultural differences in tool use and communicative behaviours between groups of wild chimpanzees (Boesch & Tomasello, 1998). Nevertheless, expressions of joy were not expected to be unduly affected by observations with captive groups, since facial expressions of joy have been reported in chimpanzees across a range of wild and captive environments.

Further important considerations favoured collecting observations of chimpanzees in captive settings. The availability of infants was a key factor. Observations of three one-year-olds from the Primate Research Institute were already available. Four chimpanzee infants were also readily available for observation at Chester Zoo and observations of all infants at 12-months-old and 15-months-old could be collected within 8 months. Chimpanzee infants are rarely so readily available in one captive setting as breeding is generally carefully controlled. Moreover, comparisons between two groups of chimpanzees were planned. Comparing the infants from the Primate Research Institute to a wild setting would introduce unnecessary confounds (noted above), whereas comparing them to infants from another captive setting, i.e., Chester Zoo, would allow for cross-group comparisons of behaviour with the basic characteristics of the environment and the group remaining relatively constant and similar (more details about the characteristics of the two groups are given in Chapter 4). In addition, relatively unobstructed observations for long durations were more likely to be possible in captivity than in the wild. This facilitated the collection of

repeated observations of each infant which was important in understanding the socialisation of joyful contexts.

C.2. Human Samples

Videotapes of a group of 1-year-old humans from the Nso community, a traditional subsistence farming village in Northwest Cameroon, were already available as a result of a collaboration established by Bard, my Director of Studies, with Keller, Professor and Head of the Department of Culture and Development, at the University of Osnabrueck. In addition, observations were collected from a sample of British infants residing in Southeast England. However, there was insufficient time to code the British sample and therefore the results of the Cameroon groups are compared with published reports from typical Western human infants. It was expected that the British sample, had they been coded, would not differ in major ways from well-researched infants raised in typical Western settings, i.e., middle-class US samples.

C.3. Cross Group Comparisons

The two groups of chimpanzees were directly compared (see Chapters 4 and 5) with the aim of understanding the degree of flexibility in the socialisation of joy in similar though not identical group settings. The Cameroon Nso group was compared with published data of other human groups (Chapter 6) with the aim of delineating the effects of culture on the socialisation of human infant joy. The Nso community is rural and caregivers tend to hold interdependent values

and collectivist beliefs, whereas British and American communities are urban and caregivers tend to hold independent values and individualist beliefs (see Keller, 2007, for further details). Chimpanzee and Cameroon Nso comparisons were also possible because of the use of the same coding system across groups. The aim was to explore similarities and differences in the expression of joy across species and contribute to theories about the evolution of joyful expression. It must be noted, explicitly, that it cannot be assumed that differences between the groups are due to species differences. There are many additional differences between groups, including group-specific cultural elements (see Leavens, Hopkins, & Bard, 2008, for further discussions of this issue in comparative psychology).

How culture is perceived as a variable, however, is strongly influenced by discipline: Cultural psychology tends to argue that human behaviour is determined by unique individual cultures that can be compared to each other only to a very limited extent, whereas cross-cultural psychology tends to seek to understand universal behaviours as well as differences. The 'emic-etic' distinction, referring to different views about the proper standpoint for studying human behaviour, is also useful to consider in relation to the study of culture (Headland, Pike, & Harris, 1990). The Etic approaches emphasise similarities in behaviour based upon a standpoint from outside a particular culture, whereas the emic approaches emphasise differences and is based upon studies from inside a culture. The cross-cultural study of human development has an affinity to the anthropological approach as evident in the pioneering studies of child rearing across diverse cultures by Mead and Macgregor (1951) and Whiting and Whiting (1975 Developmental psychology became increasingly interested in cultural differences towards the end of the 20th Century amid concerns that the prevalent

non-contexual approaches were inadequate to capture environmental influences on human development. Most developmental psychology textbooks now include sections on culture and development (e.g. Cole, Cole, & Lightfoot, 2005). This thesis aims to explore the degree of similarity across cultures by microanalysing joyful expressions and their contexts in the Cameroon Nso infants and comparing to published studies of infants in different cultures.

A cross-cultural developmental approach uncovers a range of variation in development that is not possible to discover using any single-culture study (Bard et al., 2005). With increased coverage of variation, it also becomes more possible to distinguish between biological and environmental influences. Greater commonality or universality might point to a greater degree of biological underpinning, although shared social structures would need to be ruled out as a cause. Increased diversity across cultures points to a stronger degree of environmental causation. It must be noted, however, that a great deal of developmental change is the result of the interaction between genetic and environmental variables. Another advantage of cross-cultural comparative research is the possibility of disentangling variables that may be highly associated in one culture by discovering another culture where these variables are disassociated or associated differently. For example, Bard (2005; in press) and associates (Bard et al., 2005) found an inverse relation of cradling contact and mutual gaze that explains how chimpanzee infants might develop high levels of mutual gaze (if caregivers give them low levels of cradling contact), or low levels of mutual gaze (when caregivers give high levels of cradling contact). Lavelli & Fogel (2005) and Keller (2007) described the same outcomes in cross-group comparisons with humans. Developmental psychology, without the cross-cultural

perspective, would characterise high levels of mutual gaze as the norm, and low levels as aberrant. The cross-cultural comparative perspective is also important as a corrective for researchers' ethnocentrism. By seeing a phenomenon develop differently in another culture, researches become sensitive to the cultural basis of their own beliefs (Kagitcibasi, 1996).

Researchers have categorised culture in different ways, including the most common dimension of individualism - collectivism, and the independent - interdependent dimension (although these dimensions overlap, the latter is more focused on ideas of identity and beliefs about agency). Individualist cultures are ones in which individual needs, wishes and desires are valued over collective needs, wishes and desires. People are encouraged to express themselves and develop their individuality. In Collectivist cultures the needs of group are valued, and hierarchy and status are widely recognised and formalised (Hofstede, 2001, from management literature). On the independent – interdependent dimension, independent construals of the self are common in modern Western society whereas interdependent construals are common in more traditional rural and non-Western societies. In cultures with an independent view of the self, such as America, individuals are socialised to believe they are independent, autonomous, unique, and free from social influence and their self construals focus on their own internal attributes. In contrast, in cultures with an interdependent construal of the self, such as Japan, individuals are socialised to meet social responsibilities and self construals focus on their relationships with others and their social status. Independence and interdependence can be seen as cultural schemas i.e. culturally mediated frames of reference that organise all aspects of social life (Kitayama & Markus, 1995). The choice of the interdependent Cameroon Nso group and the

independent British group was motivated, in part, by the desire to study how the different self construals might influence socialisation of emotional expression. Although the prevalence, validity, and relevance of these dimensions are the subject of continuing debate, it is nevertheless true that the Cameroon group strongly contrasts in child-rearing strategies and in the socialisation of the development of self to typical British or other Western groups. Conclusions on cultural differences are limited in this thesis because the British comparison group has yet to be analysed and, therefore, comparisons are drawn only against initial observations from the British sample and from published studies of Western infants with different methodologies and research aims. However, it is hoped that direct comparisons of the Cameroon and British samples will be conducted at a later date. Further limitations of the methodological approach are discussed in the following section.

D. Limitations of Methodological Approach

The main limitation of this study is that only a selection of infants' daily life was under observation. Infants were observed in their typical daily environment but other less-typical settings were not included though they still may have been contexts for infants' joyful expression. For the chimpanzee group, no observations were made in the sleeping quarters. For the human groups, no observations were made during family times at evenings and weekends, during outings and other organised social activities, or during child care settings. Therefore, the observations of the human groups are biased towards infants with their mothers rather than with their fathers, older siblings, or other carers. This is

relevant because fathers and older siblings may be more likely to engage in boisterous types of play with infants. Moreover, observations of the human infants only cover a small proportion of the infants' day. As is usual in human infant studies, mothers selected times when they were happy to be filmed and these times typically avoided meal-times and bed-times.

A further limitation is that the studies in this thesis focus on the infants' experience of joy rather than mothers' interpretation of infant joy. Therefore, the contexts of joy can be described and the meanings inferred based on knowledge of the culture and observed behavioural outcomes rather than knowledge from the infants' mothers. So, the meanings and values that mothers in the human studies placed on infant play and joyful emotional expressions remains an open question (though see Keller, Voelker, & Yovsi, 2005, for some discussions of infant emotions by Cameroonian Nso and German mothers).

Finally, although this is a developmental study, in the sense of looking at infants at a developmentally important point in time, it is not a developmental study of joy, *per se*, that is, it does not include a longitudinal or cross-sectional comparison. The primary objective in this study was for comparisons across cultures and species, and to control the effects of postnatal experience through the observation of all participants at the same postnatal age.

E. Conclusion

The specific aims of the research were to describe and compare the ways that infants from different cultures and primate species express joy across a variety of contexts (play type, and age/sex classification of play partners), and to

explore how socialisation (their responsiveness to the infant) influences the infants' joy. A cross-cultural and cross-species approach was applied to naturalistic observations of one-year-olds to capture the richness of joyful expression in everyday contexts. The ethological methodological approach has substantial benefits, and minimal limitations, in comparison to alternative approaches, for the research questions asked in this study. A single coding scheme was designed to be applicable across all research groups in order to meet the research aims and its development is described in the next chapter.

Chapter 3. The Coding Scheme

A good coding scheme is critically important to the success of observational research (Bakeman & Gottman, 1979). The development of a coding scheme for this research was particularly challenging as it had to work across diverse research groups – British infants, Cameroonian Nso infants, and chimpanzee infants - so that the results were directly comparable. This was essential to allow the overarching research questions concerning the evolutionary heritage and functions of joyful emotions to be addressed through cross-species comparisons. The coding scheme had to be general enough to allow statistical comparisons to be made across groups while still retaining enough detail to capture the characteristic behaviour patterns of each group. I realised that I would need several levels of codes within the overall coding scheme to answer my research questions. To address the socialisation of joyful emotions, which typically occur in the general context of play, first of all play had to be distinguished from all other activities in the naturalistic observations. Then, various types of play and play partners had to be identified along with the presence or absence of both infant joy and whether or not play partners' match the expression of infant joy. To address the whole body expression of joy, joy had to be coded in a way which determined whether facial joy, motor joy, and vocal joy were present or absent. In total, this meant that six levels of coding were required: play, play type, play partners, level of engagement of play partner, joyful expressions, and matching of infant joy by play partner.

In this chapter, the process of developing the coding scheme is summarised. It begins with an introduction to the video material which was the basis for developing and testing ideas for codes. I then describe how I developed the six levels of the coding scheme looking at each level in turn and considering the relevant literature, the process of refining the codes, and the final solution. The final coding scheme (see Appendix A) was achieved only after much trial and error over the course of a year.

A. The video material used to develop the coding scheme

The first step in developing the coding scheme was to closely examine and describe the initial video observations to generate ideas for codes. This section describes the videos that were available for this process followed by some of my initial exploratory observations of the videos.

A.1. The Video Material

When I began to develop the coding scheme I had access to videos of chimpanzee infants, Cameroonian Nso infants and British infants. I had personally filmed 12 hours of video of two 12-month-old chimpanzee infants at Chester Zoo. I had access to 10 videos of Cameroonian Nso infants, each 30 minutes duration (courtesy of Relindis Yovsi from University of Osnabrueck), though these were from a pilot study and not the final videos from Hiltrud Otto that I used in the studies in this thesis. Also, I had personally filmed two 13-month-old British infants while they were in an observational laboratory with

their mothers and older pre-school-age siblings. This laboratory room was set up to look like a typical living room, with sofas and a range of toys. This was a pilot test to test the effectiveness of laboratory observations and multiple camera angles before I collected more observations of British infants (naturalistic observations in the home were the final chosen method for the British infants). To supplement the pilot observations of the British infants, I had access to a video of a gathering of six British mothers and their 15-month-old infants. This 50-minute video was filmed by Brenda Todd as the mothers and infants gathered in a laboratory and played with toys as they waited to take part in a research study into mirror-self recognition (Bard, Todd, Bernier, Love, & Leavens, 2006).

A.2. Initial Observations and Description

The first step in developing the detail of the coding scheme was to familiarise myself with the playful activities of infants from all three research groups and their expressions of joy during these activities. This involved viewing the video material and producing written descriptions. In this section, I provide a few examples of the descriptions of joyful expressions from each research group.

A.2.a. Chimpanzee infants.

The chimpanzee infants spent a lot of time close to their mothers and mothers occasionally tickled their infants, as in the following example with Donna and her mother:

> Donna is sitting between her mother Lizzie's knees while Lizzie is reaching up and playfully hitting an adult chimp who is swinging above

> her head. Lizzie makes a play face as she looks up and Donna looks up and also makes a play face. Donna reaches backwards and lightly touches her mother's face. Her mother starts to tickle Donna's stomach with her fingers as well as tickling Donna's neck with her mouth. Donna makes a play face and reaches one hand over her head to her shoulders and then both hands together reach over her shoulders. Donna lies back onto the ground and her mother starts to tickle her under her arm with her fingers. Then, her mother gets distracted by other chimps briefly but then turns her attention back to Donna. She tickles her on her stomach and mouth again. Donna's grandmother comes and stands next to Lizzie and hits Lizzie playfully but she is not distracted from tickling. Shortly after, Lizzie stops tickling Donna and looks around.

Infants are also confident enough to play some distance away from their mother, though the mother is always within a few metres and they run back to their mothers as soon as any minor conflict arises within the group. When away from their mothers the infants sometimes engage in gentle forms of play fighting with their peers, with some uncertainty, as in the following example with Carlos, Frankie and Dido. At the time of observation, Carlos was 12 months, Frankie and Dido were both 14 months:

> Carlos, Frankie and Dido are climbing on the cargo net together. Frankie reaches out and grabs at Carlos's back while making a play face. Carlos turns round and makes a brief play face but his top teeth are exposed and he looks unsure and starts to climb away. Dido then hits Frankie but without making a play face. Frankie makes a small play face with her top teeth exposed. Frankie moves away a little and then she turns around and

> makes a wider play face without exposing her teeth. Carlos follows Frankie and they grab at each other gently with making wide play faces though sometimes the top teeth are visible. Frankie mouths Carlos's arm and Carlos mouths at Frankie's back. Dido then hits Frankie on the head without making a play face. Frankie looks at Dido and makes a play face but then she moves away. Carlos goes and hugs Dido.

The chimpanzee infants were sometimes observed to express joy when they were playing alone on the cargo nets and ropes as in this example with Carlos:

> Carlos is on the cargo net and no other chimps are visible in the near vicinity. He leans back on the cargo net, makes a small play face then raises his arm over his head and hits the cargo net playfully before climbing onto the rope. He holds on with all 4 limbs are climbs along the rope for a few seconds then hits out at the cargo net again with his arm. He drops his legs down while making a small play face. Then he makes another play face as he hangs upside down on the rope.

The chimpanzees would also play with objects by themselves as in the following example with Frankie:

> Frankie is hanging onto the climbing frame high up in the indoor enclosure. Her mother is sitting on a platform about a metre away. Frankie holds onto the frame with her feet and one arm and with the other arm she holds onto a large frayed rope. She swings her body backwards and forwards repeatedly as well as repeatedly waving the arm holding the rope. She makes a small play face with a narrow mouth and the corners of her mouth retracted. Her mother does not look at Frankie throughout this episode but instead looks around elsewhere and examines her hand.

A.2.b. Cameroonian Nso Infants.

The Cameroonian Nso infants were typically surrounded by their mother, other children, and adults, during the observation periods. Mothers and older children often initiated play activities involving a variety of household objects and small toys, as in this example with a male infant referred to here as R:

> R is sitting on the ground surrounded by his mother, a girl aged about 11-years-old, and a boy aged about 8-years-old. Mother puts a soft toy dog on the ground in front of R. R laughs with delight and then everyone else laughs at R. The boy picks up the toy dog and makes it jump towards R. R makes positive vocalizations, squeals with delight, and grabs at the toy. R throws the toy to his mother and she throws it back to him. R throws it back to his mother but this time the young girl picks it up and puts it on R's head. R reaches his hand up to his head and smiles with a wide open mouth. The girl sits the toy dog on an upturned bowl and R reaches out for it making positive vocalisations. The boy grabs the toy and puts it down R's t-shirt and R tries to crawl away. Everyone laughs. The boy puts the toy dog underneath the bowl and then turns the bowl over to reveal it. When the toy dog is revealed, R smiles and kicks his legs up and down against the ground.

Singing, clapping, and drumming were often directed towards infants. Infants would be encouraged to join in with the fun, as illustrated by the following example with the same infant, R:

> R is mildly distressed so his mother picks him up and bounces him on her lap. As she does so, she smiles broadly at him and sings. A young boy comes over and looks at R on his mother's lap. R laughs at him. Mother

continues to sing and the boy nods his head in time with the song while looking at R. R waves his hand at the boy and the boy responds by waving both his hands and laughing. Mother talks to R and smiles at him. R laughs then mother laughs. The mother and young boy sing and the boy lightly pokes R in the stomach. R smiles and waves his arms about.

A.2.c. British infants.

The British infants spent a considerable amount of time playing with the new toys provided in the two different laboratory settings. Mothers would typically get involved in the object play, sometimes directing infants' attention to new things and sometimes responding to infants' actions. The following example is from the videos supplied courtesy of Brenda Todd and colleagues and describes an interaction between a mother and her 15 month old daughter referred to here as B.

B's mother squeezes a toy that makes a noise and says "ooh!". She gives the toy to B and B also squeezes the toy and gives a little laugh. B keeps squeezing the toy then she laughs and turns to look at her mother. B's mother laughs. B's mother shakes a rattle then B gives her mother the squeezy toy with a small smile and goes to get a ball. B throws the ball to her mother who then bounces the ball. They play with the ball and squeezy toy for a short while. B gives her mother the squeezy toy and vocalises "eh". Her mother squeezes it and laughs then gives it back to B. B's mother picks up the ball and when squeezing it finds that it blows air out. B's mother then squeezes air out against B's cheek and head. B and her mum both laugh.

In the videos taken in the Portsmouth infant laboratory, infants were observed with mothers and older siblings. The older siblings would sometimes get involved in manipulating the objects alongside the infant but were not observed to give directions to the infant. The older siblings seemed to prefer exploring on their own, rather than playing with their younger siblings, though this was perhaps influenced by the novelty of the environment. Mothers divided their attention between their two children so infants also had time to play with objects on their own. Occasionally, mothers would initiate a game to involve both children as in this example with a 13-month-old boy, referred to as D, and his 4-year-old sister:

> D's mother and sister are sitting on the floor throwing a ball to one another. D walks towards his mother and holds a rattle out to her with a smile on her face. His mother ignores the rattle and throws the ball to D's sister while asking D if he is going to get the ball. D smiles as he turns around and tries to get the ball but he is too slow. D's mother and sister continue to throw the ball. D's mother asks him where the ball is and his sister smiles as D turns in a circle and smiles. D's sister throws the ball away to the side rather than back to her mother and her mother says "Ooh" as it hits another toy. Everyone laughs. D's mother retrieves the ball and throws it to D's sister and asks her to throw it back. D stands between his mother and sister and makes positive vocalisations "he he ah". D's sister says she is going to throw the ball to her brother and she smiles at D as he reaches out for the ball as she throws it at him.

B. The Six Levels of Coding Within the Overall Coding Scheme

My observations and descriptions of chimpanzee, Cameroonian Nso, and British infants generated many ideas about the specific codes required at each level of coding. These ideas were further developed through an iterative process which involved comparing my own ideas to existing classifications of play and joy in relevant literature, pilot testing codes on small sections of the videos, identifying ambiguities, checking that a suitable level of detail was being captured to illuminate the similarities and differences between the research groups, and making revisions. Additionally, I checked with researchers at the University of Osnabrueck, Hiltrud Otto and Relindis Yovsi, that my codes were relevant and valid in light of their knowledge of the Cameroonian Nso culture. In my initial applications of the coding scheme, I tested two different software programs designed for behavioural coding, Observer (Noldus, 2006) and INTERACT (Mangold, 2006), before deciding that INTERACT was the most appropriate for my purposes. The initial analyses were used for conference presentations and this process allowed me to evaluate the effectiveness of each of the six levels of the coding scheme at generating meaningful results. This section describes the process of development for the six levels of coding that make up the overall coding scheme: play, play type, play partners, level of engagement of play partners, joyful expressions, and matching of joyful expressions by play partners.

B.1. Level 1: Play

The first level of coding was designed to cut down the amount of video to be analysed by distinguishing the behaviour of interest – infant play – from other everyday activities. Although play appears to be a relatively simple concept and easily recognisable in human and chimpanzee infants, none of the many attempts at defining play has fully succeeded in capturing its character. Indeed, the definition of play is a controversial issue. Three broad approaches to defining children's play can be identified, play as context, play as a disposition, and play as behaviour (Rubin, Fein, and Vandenberg, (1983). It is worthwhile considering each of these attempts to define play in this section so that my own definition and its limitations can be understood.

B.1.a.Existing definitions of play.

Defining play by context is the simplest approach. This approach avoids an exact definition of play but instead assumes that play reliably occurs in certain contexts. For example, those wishing to observe children at play may choose to observe children at playgroups or in playgrounds. As well as naturalistic observations, settings conducive to play may be created by researchers in the home or the laboratory. Many studies provide mothers and infants with a range of toys to generate play in order to study emotional expressions and behaviours (such as cooperation and shared attention) and in such studies the lack of a precise definition of play is of little consequence. Cultural expectations of play greatly influence this approach. Children from non-Western cultures may not have equivalent structured opportunities for play, leading to difficulties in making cross-cultural comparisons (Rubin, Fein, & Vandenberg, 1983). In general, this is

a narrow approach to play as it neglects the spontaneous playfulness that can occur in any context.

Defining play as a disposition is an alternative approach that, in theory, allows play to be identified in any context. Play is defined according to the motivation and frame of mind with which one approaches an activity. At its simplest level, the motivation to play is to have fun. When children and adults are asked to define play, fun is a central feature in their responses (Sutton-Smith, 1997). The dictionary definition of play also captures the element of fun: "play, v., to engage in activity for enjoyment and recreation rather than for a serious or practical purpose; to amuse or divert oneself; to engage in fun, games, or merriment" (OED Online, 2006, June). Some scientists argue that the best definition of play is one that has its basis in our everyday understanding of play. Schwartzman (1982), for example, proposes that play is a distinct attitudinal mode that can be adopted towards any activity. Similarly, Lewis (1982), in an article *Play as Whimsy*, focuses on the affect associated with play and states that:

> No single behaviour or set of behaviours can capture play because of its ideographic nature. What is play for one may be the work of another. Play appears to be a private act and the external manifestations of it form no single coherence. . . . We hold that the affective quality of play is its fundamental importance *which does not change and is its invariant feature.* (p. 166)

This definition has ecological validity but, unfortunately, has limited practical use for scientific investigation. Unless the researcher can ask an individual to report when they are in a playful frame of mind (impossible when infants are the subjects), then play is hard to identify with any certainty with this approach. Any

activity could be play. In the field of animal research, inferences about an animal's frame of mind or emotional state, without the support of any specific behavioural indicators, are likely to result in accusations of anthropomorphism (Smith, 1982). Observational research with humans and chimpanzees could rely on smiles and laughter as external indications of enjoyment. However, these expressions appear only intermittently during play, and in some activities that are generally regarded as play they may not appear at all (Power, 2000). For these reasons, the play as fun approach is generally regarded as too vague.

Play as fun is not the only dispositional approach to play. In their review of the literature on children's play, Rubin et al. (1983) describe six dispositional factors, from a variety of theoretical backgrounds that attempt to differentiate a playful state of mind from other states of mind. The six factors are intrinsic motivation; attention to means rather than ends; dominance of the individual rather than the stimulus; disregard for the usual instrumental meaning of objects; freedom from external rules; and active engagement. Despite the scientific language, none of these factors on their own provide a suitable definition of play. Some factors may only apply in particular contexts, and observers are still required to make inferences about an individual's frame of mind. Rubin et al. (1983) acknowledge that while these factors may "provide a firmer base for serious theorising . . . even these fall considerably short of offering a guide to the *observation* of play behaviour" (p.700). The idea of play as disposition has not proved to be of much practical use in recent years but there have been some attempt to incorporate the motivational and affective qualities of play into the behavioural approach.

Defining play as behaviour is the most common approach (e.g. Bekoff & Byers, 1981; Burghardt, 1984, 2006; Fagen, 1984; Power, 2000). While there may be an internal disposition towards play, play is also thought to be evident in distinctive behaviour patterns. The simplest behavioural definitions consist of lists of different behaviours that are typical regarded as play in a particular group. For infants in Western cultures, for example, a definition of play would include activities such as manipulating toys, games such as peek-a-boo, and language games. The challenge has been to provide a behavioural definition of play that can apply across diverse groups of humans and animals and identify less familiar types of play. One often cited definition is given by Bekoff and Byers (1981) in their review of mammalian play: "*Play* is all motor activity performed postnatally that appears to be purposeless, in which motor patterns from other contexts may often be used in modified forms and altered temporal sequencing" (p.300). This definition was revised by Martin and Caro (1985) to more clearly specify the meaning of 'purposeless' and the types of motor activity modifications that would be observed during play:

> Play is all locomotor activity performed postnatally that *appears* to an observer to have no obvious immediate benefits for the player, in which motor patterns resembling those used in serious functional contexts may be used in modified form. The motor acts constituting play have some or all of the following characteristics: exaggeration of movements, repetition of motor acts, and fragmenting or disordering of sequences of motor acts. (p.65)

More recently, Burghardt (2006) has provided a definition that builds on, and goes beyond, the boundaries of the previous definitions. Five criteria have to be

met, according to Burghardt, before behaviour can be confidently labelled as play. Two of the five criteria reflect previous definitions. Firstly, the behaviour should have limited functional value, in that it does not contribute to immediate survival, and secondly, it should differ from fully functional behaviour in the structure or temporal sequence of the motor patterns. A third criterion is that the behaviour should be initiated voluntarily by an individual. This criterion can accommodate a dispositional approach, such that play is initiated for enjoyment. Alternatively, it can accommodate a more objective approach, such that play is initiated because of some intrinsic reward or reinforcement in its performance. A fourth criterion is that the behaviour is performed repeatedly during at least part of an individual's development, typically but not exclusively during childhood. The final criterion is that an individual must be relaxed and free from stress. In one sentence, Burghardt(2006) defines play as "repeated, incompletely functional behaviour differing from more serious versions structurally, contextually, or ontogenetically, and initiated voluntarily when the animal is in a relaxed or low-stress setting" (Burghardt, 2006, p. 82). This description appears to be the most comprehensive and rigorous to date.

The above approaches offer positive definitions of play; defining it by what it is rather than what it is not. Others approach the issue of defining play, at least in part, by specifying behaviours which appear similar to play but which are excluded from their definitions of play. Exploration and curiosity can share many behavioural characteristics with play but, driven largely by the analyses of Berlyne and Hutt in the 1960s, arguments have been put forward to separate these behaviours from play (see reviews by Burghardt, 2006; Rubin, Fein, & Vandenberg, 1983). One of the main arguments is that exploration has a clear and

immediate function, to gather information, whereas play is defined as having no immediate function. Furthermore, exploratory behaviours appear to be more stereotypical than play behaviours with different physiological indicators. These behaviours typically occur before the onset of play and are characteristic of novel rather than familiar situations (Burghardt, 1984). However, analysis of the difference between exploration and play has largely been restricted to settings where novelty can be controlled (Rubin et al., 1983). In naturalistic observation, the boundaries of exploration and play are harder to identify and some disagreement exists over whether or not explorative behaviours are playful.

B.1.b. Preliminary definition of play.

My objective was to provide a general definition of play that would allow playful periods to be distinguished from non-playful periods in naturalistic observations of human and chimpanzee infants. Play as context was inappropriate for my purposes because mothers were not instructed to play with their infants but to continue with their everyday activities with playful periods arising naturally. Play as behaviour felt too restrictive at this stage. Applying the rigorous five-point criteria suggested by Burghardt (2006) to every behaviour in hours of video seemed unnecessarily stringent and time-consuming and more appropriate for observing species that are less familiar to us than humans and chimpanzees. Many studies of play in primates proceed without a rigorous behavioural definition of play as commented on by Bateson (2005):

> In the case of play, the testing issue of definition is often shrugged off because, it is claimed, we all recognise play when we see an individual doing it. . . . When a young chimpanzee plays, observers readily agree

> about the occurrences of a variety of different components of its activities; their quantitative measurements correlate strongly with each other. (p. 13)

Therefore, my initial approach was to regard play as a disposition. Play was defined as any activity in which the infant was playful. Although this circularity may be uncomfortable to some, I felt that playfulness could easily be identified by myself and the second coder based on our knowledge of infant play. The ability to distinguish play from non-play is made easier in the study of human and chimpanzee infants because a large proportion of their time is spent playing (Sutton-Smith, 1997; van Lawick-Goodall, 1968). It is usually clear when active infants are not playing, for instance, they may be visibly distressed, feeding, or responding to a request from their mother.

The preliminary definition of play was enhanced by some additional description of the infant's affective state when playful and the general behaviours encompassed by play, and was as follows:

> *Playful:* The infant engages in playful activity at any point during an interval. During playful activity the infant's face and body will be relaxed and their eyes will be bright and alert. Playfulness can be directed towards other individuals and objects or it may be seen in the infant's energetic motor movements when alone.

The description of the infant's affect during play was based on a global interpretation of the infant's relaxed muscle tone. I avoided specifying particular expressions such as smiles and laughter, because these would be coded at a later stage and are not necessarily present during play. There were a couple of elements of behavioural description in my definition. First, play was regarded as an activity and therefore not something that can be engaged in vicariously as an onlooker.

Second, play could incorporate both social and solitary behaviours and it was important to state this explicitly because solitary play has generally been neglected in studies of play (Pellegrini & Smith, 1998; Power, 2000). Exploration was not excluded from my definition of play; indeed exploratory behaviours would meet my criteria for play. Exploration and play are hard to separate unless novelty is controlled (Rubin, Fein, & Vandenberg, 1983). In this study, no novel objects were supplied but even so the familiar objects may continue to provide new learning opportunities in line with the infant's developing abilities.

The preliminary coding scheme for *play* consisted of four mutually exclusive and exhaustive codes: playful, not playful, not visible, and not sure, which were applied to 20-second intervals. Event coding, where the exact start and stop times of play bouts were recorded, was tested but was found to be unnecessarily precise and it took much longer to identify start and stop times than to make a simple decision about whether or not play was evident in an interval. Further levels of coding would describe these play intervals in more detail and identify short periods of non-play that were missed by the broad-brush approach at this current level.

B.1.c. Final definition of play.

The preliminary *play* coding scheme was tested on the video material described earlier in this chapter and it was easy to apply based on my knowledge of infants. However, I encountered some uneasiness with its lack of specificity when discussing my approach with others. Therefore, I decided that the final version would benefit from a greater description of what play looks like in human and chimpanzee infants in behavioural terms. This would help others less familiar

with human and chimpanzee infant play to understand and visualise the type of activities I was coding as play. This was particularly important for the chimpanzee research because although the second coder for the *play* coding scheme was very familiar with human infant play she was less familiar with chimpanzee infants.

The final coding scheme for *play* consisted of three mutually exclusive and exhaustive codes: playful, not playful, and not visible. The definition of play in the final coding scheme combined both dispositional and behavioural factors, as in the preliminary version, but has greater specificity about the behavioural elements. Playful was defined as follows:

> *Playful:* The infant engages in playful activity at any point during the interval. When playful the infant will appear relaxed, alert, and positively engaged in an activity which does not meet any immediate physical needs such as sustenance or comfort.

The definition acknowledges the importance assigned to the lack of immediate function in the behavioural definitions of play by Burghardt (2006) and others (e.g. Bekoff & Byers, 1981; Martin & Caro, 1985). Furthermore, the definition was supplemented with a list of typical playful activities that I had observed in the research groups. Typical play activities of chimpanzee infants include climbing, tumbling, swinging, chase games, object manipulation, gentle wrestling and hitting, and tickling. Typical play activities of human infants include crawling, walking, running, being tickled, object manipulation, repetitive language games, object games, singing, and dancing to music.

The definition of not playful was defined as follows:

Not playful: The infant is not playful at any point during the interval. The infant may be sleepy, distressed, observing others, or engaged in some activity that meets immediate physical needs.

Examples of activities that were regarded as not playful activities were also included in the definition including eating, following mother around, and verbal and gestural requests for food or comfort (see Appendix A for full list).

In this final version of the *play* coding scheme, the code 'unsure' was dropped. If there was any uncertainty about whether or not an infant was playful then it would be coded as 'not play'. The intervals were also lengthened from 20s to 30s for speed and because precision was not essential at this level of coding.

B.2. Level 2: Play Type

The *play type* coding scheme was to be applied to all the 30-second intervals of play that had been identified by the *play* coding scheme. Play types have been categorised in numerous ways by different researchers and so it was essential to familiarise myself with the relevant literature alongside reviewing my own videos. This section summarises some of the play types that are relevant for human and chimpanzee infancy and then moves on to describe my preliminary and then final coding scheme for *play type*.

In animal research, play has typically been sub-categorised into three types – social, object, and locomotor (e.g. Bekoff & Byers, 1981; Fagen, 1981; Lewis, 2005; Burghardt, 1998). These play types can be defined by the individual's focus of attention, as described by Bekoff and Byers (1981):

> If the activity is directed toward another living individual, it is called social play; if it is directed toward an inanimate object(s), it is called object play; if the activity carries the individual in a seemingly frantic flight about its environment, it is called locomotor play. Both social and object play can be locomotory in nature. (pp. 300-301).

As acknowledged in the above quote, these types of play can overlap. A common solution is to treat the types of play as a hierarchy with social at the top. Burghardt (2006) states that: "One solution is to view these three categories as a hierarchy so that locomotor play is always solitary, chasing an object is object play regardless of any locomotion involved, and a tug of war with an object is classed as social play" (p.88). However, this approach makes it difficult to get a definite distinction between social and solitary play.

In human infancy research, there are two broad approaches to the definition of play type. One approach is similar to the approach described above for animal research: play is sub-categorised according to whether the infant is engaging in social play, object play, or locomotor play but there is an additional sub-category called joint object play. Joint object play describes times when the infant is engaging with an object and this object is also the focus of another's attention (Adamson & Bakeman, 1985). Some researchers require joint object play to include instances where the infant alternates their gaze between the object and the other individual. Chimpanzees are also capable of joint object play, though they do not necessarily alternate gaze with the other individual. Variation exist between chimpanzee groups, and also between human cultures, in the propensity towards mutual gazing and a requirement for mutual gazing may be too strict a criteria to apply to joint object attention (Bard & Leavens, 2009).

There have been several existing descriptions and categorisations of play at levels more detailed than just social, locomotor and object play. Power (2000) reviewed several observational studies of human infants during social play with peers and identified six general categories: locomotor play, imitation, social object use, language interactions, conventional games, and agnostic interactions. Another term for agnostic interactions is rough and tumble play and this appears in both human children and chimpanzees (Blurton Jones, 1976; Humphreys & Smith, 1984; Scott & Panksepp, 2003). However, the term rough and tumble play is usually reserved for older age-groups (e.g. 2.5 years and older) as one-year-olds social interactions tend to be fairly gentle. Another type of human infant play is pretence or make-believe play, which can be solitary, from early on in the second year, or social, typically from later in the second year (Scarlett, Naudeau, Salonius-Pasternak, & Ponte, 2005). Aldis (1975) categorised many types of play found in humans and animals and many social play types had solitary equivalents. Some of Aldis's categories that may be relevant for infancy include social chasing games and solitary play flight; playful biting or mouthing of playmates and of objects; wrestling with playmates and wrestling with objects; tug of war with playmates and tugging objects; and also sliding, falling and rotational acrobatics which could occur during social or solitary play. Knowledge of these existing definitions of play types was the starting point for the development of my coding scheme for *play type* and I was keen to ensure that solitary play types were as well defined as social play types.

B.2.a. Preliminary definition of play type.

A distinction between social and solitary play was important for my research aims because I wanted to describe the play context of all joyful expressions and then apply additional levels of description to social joy (play partners, level of engagement of play partners, and matching of infant joy by play partners). My initial codes for *play type* were kept fairly simple because I did not want to overcomplicate the coding more than was necessary. Social play was divided into four types: locomotor (including chasing, climbing, and acrobatics when performed with play partners), object exchange (playful competition for objects, passing balls), object manipulation (shaking, tugging, hitting, and exploring objects), and engagement (any other form of social play where objects or locomotion were not the focus of attention, including wrestling and communicative games). Solitary play was divided into two types: object (any form of manipulation and exploration) and locomotor (climbing, running, jumping, and acrobatics). All play types were determined according to the infant's focus of attention. The codes *not playful* and *not visible* were also necessary because although the sections of the videos to be coded had already been defined as containing play the coding had been done in 30-second intervals and play type was to be coded in shorter intervals. At this preliminary stage, I experimented with coding in intervals of 5-seconds and 10-seconds.

B.2.b. Final coding scheme for play type

After testing the *play type* coding scheme against the available videos, it was apparent that social play warranted further sub-types to allow more detailed examination of the similarities and differences between the research groups.

Social engagement play was further divided into five types: communication (playful gestures and vocalisations with others); tickle (either being tickled or tickling another); mild contact (mild forms of hitting, grabbing, and poking); rough and tumble (wrestling, rolling about, being swung about by an older individual); and rhythmic (singing, dancing, and music making). Communication, tickle, mild contact, and rough and tumble play were features of both human and chimpanzee play though to different degrees. Rhythmic social play was evident in several of the Cameroonian Nso pilot videos and the Cameroonian researchers at University of Osnabrueck advised that this was an important element of Cameroonian culture that would be useful to include in the coding scheme. Social object exchange and social object manipulation remained as codes, as did social locomotor, and social other was added to catch any other types of play. The solitary play codes, solitary object and solitary locomotor, were retained for the final coding scheme with the addition of solitary rhythmic play and solitary other. Solitary rhythmic was added as it had been observed on one occasion in the Cameroonian Nso pilot videos and given the importance of music to the culture it was included to complement the social rhythmic code. Not playful and not visible remained as codes. Therefore, there were 15 mutually exclusive and exhaustive codes for play type in the final coding scheme[3]. Each of these was defined in behavioural terms (see Appendix A). The codes were applied to 5-second intervals because play types were found to switch rapidly. In 10-second intervals, two play types were often present forcing the coder to make time-consuming decisions about the dominant play type.

[3] For analysis purposes, the play types were often reduced to 13 codes by combining social object exchange and social object manipulation into one code, social object, and by combined social mild contact and social rough and tumble into another code, social contact. This was because of the relatively low observed instances of social object exchange and social rough and tumble play.

B.3. Level 3: Play Partner

The *play partner* coding scheme was designed to be applied to all 5-second social play intervals as identified by the play type coding scheme. The videos were naturalistic observations and infants were free to interact with whoever they wished during the observations. Information on the relationship of infants to their play partners and play partner ages was available for the chimpanzee infants and the British infants. However, only mothers were readily identifiable in the Cameroonian Nso videos. The relationship of other adults to the infant was not collected for the Cameroon Nso videos and it was not particularly relevant as the Cameroon Nso treat the other villagers as their extended family. Therefore, mothers were defined in the *play partner* coding scheme but all others were simply classed as adults or children regardless of their relationship to the child. Children were split into three age ranges: peers, young children (called juveniles for the chimpanzee group) and older children (called adolescents for the chimpanzee group). The age categories for chimpanzees are those that have typically be used by researchers following the definitions by Jane Goodall (van Lawick-Goodall, 1968). A code for animal was added because some of the Cameroonian Nso infants played with dogs or chickens and British infants were anticipated to play with pets as well. Play with an animal seemed to fit more with the social category than with the solitary category because it involved games like chasing or wrestling with objects together. The code 'not visible' was also necessary because on occasions it was clear that infants were engaging in social play but the play partner was off-camera. All codes were mutually exclusive and exhaustive. Where there were two play partners engaging with an infant within an interval, the researcher had to choose the dominant play partner. In practise, the

short 5-second interval meant that it was usually easy to determine the main play partner. The precise age ranges and definitions for the *play partner* coding scheme are given in Appendix A.

B.4. Level 4: Level of Engagement of Play Partner

The coding scheme for *level of engagement of play partner* was applied to all 5-second social play intervals as identified by the play type coding scheme. Level of engagement was defined to reflect play partner's investment in the play interaction. Initial observations of the videos revealed that play partners often seemed distracted during infant play and were sometimes reluctant to play or disinterested altogether. It seemed that the level of engagement of the play partner may have some influence on the production of infants' joyful expression. The coding scheme for *level of engagement of play partner* was kept very simple as it was regarded as an interesting element of the play context to explore but not critical to the research questions. There were five mutually exclusive and exhaustive codes: fully engaged, partly engaged, not engaged, other, and not visible (see Appendix A for full definitions).

B.5. Level 5: Joyful Expressions

I took a relatively straightforward approach to coding joyful expressions, by coding within each interval simply the presence or absence of facial joy, motor joy, and vocal joy. This utilises, in part, Wagner's (1997) judgement methodology, which is the most widely used method in investigations of facial

behaviour and the coder decides on the presence or absence of an expression based upon their knowledge of the expression. An alternative approach, known as the component approach, involves the objective measurement of specific elements of the expression, such as the muscular movements involved in facial expressions, and analysis of how these elements combine in systematic ways in different contexts (Ekman, Friesen, & Ellsworth, 1982). Facial Action Coding System (FACS, Ekman & Friesen, 1978) is the most commonly used objective measurement system and there is also BabyFACS for infants (Oster, 2006) and ChimpFACS for chimpanzees (Vick, Waller, Parr, Pasqualini, & Bard, 2007). There are no equivalent for the measurement systems for the coding of motor expressions and vocal expressions. In this study, the focus was on collecting a lot of joyful expressions and studying them in context. I decided not to use FACS because coding facial expressions is extremely time intensive and would restrict the quantity of footage I could look at. The muscle movements can be subtle and accurate coding would require close up video footage which would be much harder to achieve in naturalistic settings that in a controlled laboratory setting. Instead, FACS coding is being conducted through collaborations with Thorsteinsson and Bard (2009)on a selected set of expressions where there is good visibility of the face.

The interval approach to coding facial expressions means that it is not possible to provide an exact count of the number of expressions coded. To provide a count of joyful expressions, the exact onset and offset of each expression would have to be coded. This approach was briefly tested but it was quickly rejected because it is too time-consuming when hundreds of expressions are to be coded and it is not always easy to decide where one expression ends and

another begins. Furthermore, coding onset and offset information rather than intervals would have required more complex analyses than were necessary for the interval approach.

The coding schemes for each modality of joyful expression – facial, motor, and vocal – are described below.

B.5.a. Facial joy.

Each 5-second interval was defined according to whether the infant's facial expressions displayed facial joy, no facial joy, or if facial expressions were not visible. These codes were mutually exclusive and exhaustive. Facial joy was defined as smiling in humans and play faces in chimpanzees. Smiles and play faces were coded at a socially meaningful level, and not at the muscular level of FACS for the reasons already described above. Where there was any doubt about the joyfulness of a facial expression then it was coded as *no facial joy*.

For human smiling, the only criterion was that the corners of the mouth were retracted. The mouth could be closed, partly open or fully open during a smile. Cheek raising did not need to be present for smiling to be coded though it has often been regarded as an indicator of felt joy (Duchenne smiles) and smiles without cheek raising are often regarded as social tools rather than emotional signals (Non-Duchenne smiles) (Ekman & Friesen, 1982). Studies with infants suggests that all infant smiles reflect positive emotions but that the different muscular movements involved in smiling vary according to the context (Messinger, 2002, 2005; Messinger, Fogel, & Dickson, 2001). Therefore, the definition of a human smile was left relatively vague in this study with the

potential for analysis of the muscular movements of smiling by context in future studies.

Chimpanzee smiles were also referred to as play faces. Play faces are expressions where the mouth is either partly or fully open, and the lower jaw is relaxed and dropped (Parr, Preuschoft, & de Waal, 2002; van Hooff, 1972; van Lawick-Goodall, 1972). Variation has been reported in the degree to which the upper or lower teeth are visible and whether or not the corners of the mouth are retracted as so these elements were not specified for the play face code (van Lawick-Goodall, 1972). The chimpanzee fear grin shares some elements with the relaxed play face because the mouth can be open or closed, the corners of the mouth are typically retracted, and the teeth are exposed. However, the relaxed tone of the mouth muscles is the main factor that distinguishes the play face from the fear grin, along with the playful context.

Some of the variation that exists in facial expressions of joy in both human infants and chimpanzee infants can be seen in some still pictures captured from the video records (Appendix B).

B.5.b. Motor joy.

Each 5-second interval was defined according to whether the infant's motor movements displayed motor joy, no motor joy, or if they were not visible. These codes were mutually exclusive and exhaustive. Motor joy was defined mainly by the examples evident in the videos. Others have discussed joyful motor movements such as the leaping, jumping, pirouetting, sliding, falling, and acrobatics that occur during the play of animals and human children (Aldis, 1975; Darwin, 1872/1999), However, motor joy in infants' generally involved

smaller movements such as waving limbs and hitting because their motor skills were still developing. Motor joy was described as motor movements that were typically quick and exaggerated and sometimes repetitive. Similar movements can occur when infants are angry or frustrated so consideration of the context was important to ensure it was playful. Examples of motor movements include waving arms, kicking legs, hitting, stamping, bouncing, jumping and acrobatics (see Appendix A for the full list). The tickle request gesture, where chimpanzee infants reach their arms over their shoulders towards the back of their neck (Plooij, 1978, 1979), is also defined as motor joy.

B.5.c. Vocal joy.

For the human infants, each 5-second interval was defined according whether the infant's vocalisations displayed vocal joy, no vocal joy, or if they were not audible. These codes were mutually exclusive and exhaustive. Vocal joy was further split into laughter and squeals or other vocal joy including playful vocalisations and babbling. Vocal joy could not be coded for chimpanzees because the video-recordings could not pick up chimpanzee laughter which is quiet and breathy.

B.6. Level 6: Matching Infant Joy

This could have been the most difficult part of the coding scheme, as it was designed to capture the responsiveness of social partners to infants' signals, which has been studied extensively. I took a simpler approach than many. Where there were intervals of infant joy during social play, I coded whether or not play

partners matched infant joy by expressing joy via the same modality of the infant within the same 5-second interval. This meant that the responsiveness of play partners was relatively quick to code because all intervals had already been set up and the number of joyful expressions was estimated to be in hundreds. More fine-grained analysis could be done if appropriate in follow-up studies.

B.6.a. Matching facial joy

Each 5-second interval where infant facial joy was present in the context of social play was further coded to determine if play partners matched facial joy. There were three mutually exclusive and exhaustive codes: match facial joy, no match and not visible. Match facial joy was coded where the infant smiled and the play partner also smiled regardless of who smiled first.

B.6.b. Matching motor joy

Each 5-second interval where infant motor joy was present in the context of social play was further coded to determine if play partners matched motor joy. There were three mutually exclusive and exhaustive codes: match motor joy, no match and not visible. Match motor joy was coded where the infant displayed motor joy and the play partner also displayed motor joy, though the exact form of motor joy (e.g. waving, jumping, bouncing) did not have to match.

B.6.a. Matching vocal joy

Each 5-second interval where infant vocal joy was present in the context of social play was further coded to determine if play partners matched vocal joy. There were three mutually exclusive and exhaustive codes: match vocal joy, no

match and not visible. Match vocal joy was coded where the infant laughed or made other joyful vocalisations and the play partner also laughed or made other joyful vocalisations. The exact form of the vocalisations did not need to be matched.

Chapter 4. Play contexts of one-year-old chimpanzee infants in two captive settings

A. Introduction

Play is a characteristic behaviour of most young mammals and is thought to benefit motor, cognitive, and social development (Bekoff & Byers, 1981; Smith, 1982). The extended youth of primates affords plenty of opportunity for play which may assist with acquisition of the complex skills that are needed for individuals to survive and thrive in primate society (Bateson, 2005; Joffe, 1997). Amongst the non-human primates, chimpanzee play appears the most diverse with the appearance of object play in addition to various social and solitary play activities. The development of play across the chimpanzee lifespan was first described in detail by Jane Goodall after several years spent observing wild chimpanzees at Gombe Stream, Tanzania (Goodall, 1965, 1986a; van Lawick-Goodall, 1968). Other studies of chimpanzee play have often focused on the communication of playful intent through play signals, such as the play face expression, rather than on the play activities themselves (e.g. Flack, Jeannotte, & De Waal, 2004; van Hooff, 1973; Vettin & Todt, 2005; Waller & Dunbar, 2005). Therefore, despite the wealth of description of chimpanzee play, quantitative studies covering the full range of play activities are uncommon particularly for the infancy period. This study focuses on understanding the variety of play activities engaged in by chimpanzees as a backdrop to later analysis of the joyful expressions found during these play activities (see Chapter 5). Current knowledge

on the play activities of chimpanzees at different stages of development is summarised below.

In early infancy, chimpanzee infants are in constant body contact with their mothers and their first experiences of play are when mothers initiate tickle play. Infants often respond to tickling with play faces and sometimes laughter. Gradually, infants begin to initiate tickle play by pulling their mother's hands towards them while making a play face (Plooij, 1979; van Lawick-Goodall, 1968). Mother-infant play is frequent in early infancy with one study in captivity calculating that it accounted for 15% of mother-infant active interaction time during an infant's first three months, the second most frequent activity after grooming (Bard, 1994). In addition to tickle play, locomotor play is also evident in the first few months. For example, one 19-week old infant at Gombe was observed repeatedly climbing up his mother's body and then diving over her shoulders (van Lawick-Goodall, 1968).

In later infancy, from the end of the first year until about 3-years-old, mothers and infants are still engaging in tickle play but a greater variety of play is evident: mothers and infants spar gently with each other, more boisterous play occurs with siblings and peers, and locomotor play features more acrobatic manoeuvres (van Lawick-Goodall, 1968). Objects are also of interest to chimpanzee infants. For example, at Mahale, Tanzania, chimpanzees as young as two years old were observed performing repeated bouts of leaf-pile pulling; raking dry leaves along the ground by hand with the noise appearing a source of enjoyment (Nishida & Wallauer, 2003). Another study at Gombe estimated that chimpanzee infants as young as 1.5 years old were spending about an hour or two a day playing with objects (Ramsey & McGrew, 2005).

Juvenile, adolescent and adult chimpanzee play has been widely observed in the wild and captivity and typically consists of play fighting and chasing (e.g. Lewis, 2005; van Hooff, 1973; van Lawick-Goodall, 1968; Vettin & Todt, 2005). Object play has also been noted at these ages in both social and solitary contexts. During social play, objects such as branches are sometimes used to hit the play partner or to entice the play partner into a chase (van Lawick-Goodall, 1968). Solitary object play appears less common but there are anecdotal reports of activities such as repeatedly throwing stones in the air and catching them (Goodall, 1986b) and more unusual incidences where small animals are apparently played with - being swung about, hit, and carried, but not eaten (Hirata, Yamakosh, Fujita, Ohashi, & Matsuzawa, 2001).

The effect of age on the frequency of play has been measured in several studies with consistent results. Play occurs more frequently in infants than in juveniles (Mendoza-Granados & Sommer, 1995; Savage & Malick, 1977), peaking in frequency between 2 to 4 years of age and then declining with increasing age though not disappearing (van Lawick-Goodall, 1968). However, when play activities are being studied age can be a complicating factor. Often a range of ages are studied, dependent on the composition of the group, and findings from different studies can appear inconsistent. For example, in a study of the sub-adult chimpanzees at Arnhem Zoo, Netherlands, social play occurred three times more frequently than solitary play (Mendoza-Granados & Sommer, 1995) while in a similar study of the sub-adult chimpanzees at Taronga Zoo, Australia, solitary play was more frequent than social play (Markus & Croft, 1995). The greater numbers of infants in the Taronga Zoo sample (n = 6) compared to the Arnhem Zoo sample (n = 1) may have been one reason for the

differing results. The infants at Taronga Zoo engaged in steeply increasing amounts of solitary play until 30-months after which it declined to almost nothing amongst older juveniles. Object play, like solitary play, also appears to decline after infancy (Mendoza-Granados & Sommer, 1995). More skilled use of objects, rather than play, appears amongst juveniles as they begin to use objects as tools to acquire food (Markus & Croft, 1995). The play activities of chimpanzees clearly vary according to their age.

Unfortunately, few quantitative studies have sufficient numbers of chimpanzee infants to permit analysis of developmental trends in chimpanzee play and the solitary aspects of infant play have been particularly neglected. Social play is typically regarded as the most prevalent type of play in great apes (Lewis, 2005) and indeed the play of adolescents and adults is characterised by play fights and chases rather than solitary activities. Social play has also been of greater interest to primatologists because of its potential for insights into the complexities of social relationships, communication, and cognition. However, from a developmental perspective, studies of infant play would benefit from the inclusion of both social and solitary activities.

Overall, the descriptive and quantitative studies described above highlight the diverse nature of chimpanzee play, particularly in infancy. Further investigation of chimpanzee infant play is needed to provide greater detail on the types of play that infants are engaging in and at what frequency. Therefore, the objective of my first study of chimpanzee infants was to quantify the types of play and play partners in one-year-old chimpanzees. Play type was organised under two broad categories - social and solitary. In contrast to previous studies, specific types of social and solitary play were quantified and object play was not treated as

a separate category but was classified as either social or solitary. The chimpanzees were all observed at one-year-old to provide as accurate a picture as possible within a specific age range and to allow comparison to human infants of the same age in later studies (see Chapter 6). At the beginning of the second year, a wide range of play opportunities are becoming available to chimpanzee infants as mothers are beginning to allow their infants greater freedom to explore and engage in social interactions (van de Rijt-Plooij & Plooij, 1987). The information gained on infant play in this study was essential to provide the context for the study of one-year-olds joyful expressions during play and the responsiveness of play partners to infants' joyful expressions (see Chapter 5).

B. Method

B.1. Participants

Chimpanzee infants were observed at Chester Zoo, England (n=4), and the Primate Research Institute (PRI), Kyoto University, Japan (n=3). The groups were similar in that all infants within each group had been born within 6 months of each other and were receiving good maternal care. Thus, there was opportunity for observation of peer play and mother-infant play amongst other types of play. Demographic information for the infants and their mothers is shown in Table 4.1.

Table 4.1: *Demographics of chimpanzee infants and their mothers.*

Infant	Sex	Date of birth	Mother	Age of mother at birth	Previous live births
		Chester Zoo group			
Carlos	Male	6-Mar-05	Whitney	11y 9m	0
Dido	Female	29-Dec-04	Zee Zee	10y 10m	0
Donna	Female	10-May-05	Lizzie	10y 1m	0
Frankie	Female	26-Dec-04	Alice	13y 1m	1 (died in infancy)
		PRI group			
Ayumu	Male	24-Apr-00	Ai	c. 23 y	0
Cleo	Female	19-Jun-00	Chloe	19y 6m	0
Pal	Female	9-Aug-00	Pan	16y 8m	0

At Chester Zoo, the infants were living in a social group of 31 individuals. In addition to the four focal infants and their mothers, there were 5 adult males (18-40 years old), 15 adolescent and adult females (8- 35 years old), two juvenile males (3 and 6 years old), and an older infant who was born 3 months before the oldest focal infant. The 3-year-old was on the cusp between infancy and being classed as a juvenile according to the age classifications of chimpanzees proposed by Goodall (1965; van Lawick-Goodall, 1972). For this study, the 3-year-old was

classed as a juvenile because he spent most of the day away from his mother and his locomotor skills were considerably more advanced than the older infant. All infants were being raised by their mothers without intervention from the keepers. Mothers had also been raised by their own mothers at Chester Zoo.

Keepers had minimal interaction with the entire social group apart from daily health checks through bars and the supply of food. During the day chimpanzees had access to a large outdoor island and an indoor area. Both of these areas had climbing frames and platforms. Chimpanzees also had access to their sleeping areas, which were off-view to zoo visitors, from late afternoon.

At PRI, the infants were living in a social group of 14 individuals. In addition to the infants and their mothers, there were 3 adult males (19-35 years old) and 5 adult females (18-35 years old). Infants were being raised successfully by their mothers despite their mothers' early rearing histories involving human caregivers. The eldest mother was taken from the wild in infancy. Prior to giving birth, mothers had received training in infant care by watching videos of wild chimpanzee mothers and infants and through practise with a chimpanzee baby doll. The PRI chimpanzees had daily interactions with human researchers in testing areas, where they were given experimental tasks and had the opportunity to manipulate a variety of objects. Infants had been attending these sessions with their mothers since shortly after birth (Matsuzawa, Tomonaga, & Tanaka, 2006). Outside of these sessions, the chimpanzees had access to a large outdoor garden and a smaller indoor area both of which had climbing frames and platforms.

B.2. Procedure

Naturalistic observations of each infant were videotaped for later microanalysis of playful behaviours. All infants were observed at 12 months (mean 12.1, range 11.4 - 12.5) and 15 months (mean 15.0, range 14.4 - 15.5). At Chester Zoo, infants were filmed continuously for 2-3 consecutive days during zoo opening hours (typically 10 – 5) and whenever they were awake and in sight. This resulted in an average of 343 minutes per infant at 12 months (SD = 29) and 334 minutes at 15 months (SD = 20). Each video-tape was one-hour in duration so there was 5-6 hours of video tape per chimpanzee per age. PRI observations were taken from a video library of observations made during times when the infants and their mothers were in their living areas (rather than testing areas). On average there were 82 minutes of observation per infant at 12 months (SD = 33) and 63 minutes at 15 months (SD = .5). The PRI observations showed systematic variation by age with infants always inside at 12 months but outside most of the time at 15 months. Taken together the videos represent a range of playful activities for the PRI infants but, as a result, age differences are not analysed for either group of chimpanzee infants.

B.3. Coding System

There were four levels to the coding scheme: play, play type, play partner, and level of engagement of the play partner (see Appendix A for full details of the

codes). Coding was conducted using INTERACT coding software (Mangold, 2006).

Play was coded in 30-second intervals to identify periods of playful behaviour for further analysis. Intervals where there was no playful behaviour or where the focal infant was not visible were not analysed further. The mean percentage of intervals with playful behaviours for the PRI infants was 77% (SD = 7) at 12 months and 75% (SD = 15) at 15 months. Therefore, for each PRI infant, the mean number of minutes available for microanalysis was 50 (SD = 13) at 12 months and 38 (SD = 6) at 15 months. For the Chester Zoo infants, the mean percentage of intervals with playful behaviours was lower than for the PRI infants at 43% (SD = 6) at 12 months and 49% (SD = 11) at 15 months. After analysing the amount of play behaviour in the Chester Zoo videos, it was clear that less than the full 5-6 hours of observation per infant per age was sufficient to analyse play (in this study) and playful expressions (in the next study). Therefore, for each Chester Zoo infant, three hours of observation were selected at 12-months and three hours at 15-months. The hours with the most playful intervals were selected for each infant at each age and the hours with the least playful intervals were not analysed further. In the selected Chester Zoo videos, the mean percentage of intervals with playful behaviours was 52% (SD = 5) at 12 months and 49% (SD = 13) at 15 months. Therefore, for each Chester Zoo infant, the mean number of minutes available for microanalysis was 96 (SD = 10) at 12 months and 88 (SD = 21) at 15 months. Further analysis of playful behaviours was conducted in 5-second intervals.

All five-second intervals were coded for *play type* (n = 12000). Intervals where play type was coded as not playful or not visible (37% of intervals) were

not analysed further. All intervals with social play types (n = 2514) were coded for *play partner* and *level of play partner engagement*.

B.4. Reliability

Reliability of the *play* coding scheme was tested by a second coder for 396 minutes (13% of the available minutes). Observed agreement was 92%, with a Cohen's kappa of 0.83. Reliability of the *play type* coding scheme was tested by a third coder for 1676 intervals (14% of total intervals). Observed agreement was 90%, with a Cohen's kappa of 0.88. Reliability of the *level of engagement of play partner* coding scheme was also tested by the third coder for 318 intervals (13% of social play intervals). Observed agreement was 90%, with a Cohen's kappa of 0.83. Reliability was not tested for play partner because this coding scheme relied on an ability to identify all chimpanzees at Chester Zoo and PRI.

C. Results

The two groups of one-year-old infants from Chester Zoo and PRI showed considerable similarities in the contexts of play, despite differences in their level of interaction of humans. Therefore, the overall means for all seven infants are reported here with group differences only reported where significant or relevant. An alpha level of 0.05 was used for all statistical tests.

C.1. Play Types

Chimpanzee infant play was primarily solitary rather than social with solitary play accounting for an overall mean of 66.4% of play time (SD = 6.2). A repeated measures ANOVA (social/solitary play x setting) revealed a significantly higher percentage of solitary play than of social play, $F(1,5)=39.55$, $p<0.001$, $\eta^2=0.89$, with no difference across settings and no interaction with setting.

A breakdown of the types of social and solitary play engaged in by chimpanzee infants is shown in Table 4.2. Solitary locomotor play accounted for the largest proportion of play time (M = 49.6%) followed by solitary object play (M = 16.1%) and social mild contact play (M = 14.6%). There was considerable variability between individuals in the proportion of play time spent engaging in different types of play with variability particularly high for solitary object play. Solitary object play ranged from 5% to 35% of an infant's play time. Social object play was observed in 5 of the 7 infants but was a very small proportion of playful intervals (M = 1.7%). Group differences in the proportion of play time engaged in each type of play were evaluated with non-parametric Mann-Whitney U tests because of the small sample sizes in each group. The only significant difference between groups was in social tickle play, which accounted for a higher proportion of play at PRI (M = 7.5%) than at Chester Zoo (M = 1.7%), U = 0.00, p = .03.

Table 4.2: *The types of play engaged in by chimpanzee infants, as mean percentages of all playful intervals.*

Play type	**Mean**	Range	*SD*
Solitary:			
Locomotor	**49.6**	39 - 62	8.3
Object	**16.1**	5 – 35	10.3
Other	**0.7**	0 - 3	1.3
Social:			
Mild contact	**14.6**	9 – 21	3.5
Rough and tumble	**3.8**	<1 - 12	4.0
Locomotor	**9.3**	5 - 17	4.0
Tickle	**4.2**	0 - 9	3.5
Communication	**1.0**	0 - 2	0.4
Object[1]	**0.7**	0 - 3	(1.0)

[1] Social object manipulation and social object exchange were combined into one play type, social object, because only two intervals of social object exchange were observed.

In order to compare across the settings, the percentages of different play types were calculated separately for social play types and for solitary play types (Table 4.3). Among the solitary play types, the proportion of solitary play time spent engaging in locomotor play did not differ across settings, $F(1,5) = 3.51$, $p = 0.12$, $\eta^2 = 0.41$, and neither did the proportion of solitary play time spent engaging in object play, $f(1,5) = 5.30$, $p = 0.07$, $\eta^2 = 0.51$. Among the social play types, the proportion of social play time spent engaging in mild contact play did not vary significantly across settings, $F(1,5) = 0.03$, $p = 0.88$, $\eta^2 = 0.01$, while the proportion of social play time spent engaging in rough and tumble play did vary

significantly across settings, $F(1,5) = 7.89$, $p < 0.05$, $\eta^2 = 0.61$. Chester infants spent 17% of their social play time in rough and tumble play compared to PRI infants who spent less than 3% of their social play time in rough and tumble play. The proportion of social play time spent engaging in tickle play also differed significantly across settings, $f(1,5) = 16.09$, $p < 0.01$, $\eta^2 = 0.76$. Chester infants spent less than 5% of their social play time in tickle play compared to PRI infants who spent 23% of their social play time in tickle play.

Table 4.3: *The types of play engaged in by chimpanzee infants from two settings, as mean percentages of social play intervals and solitary play intervals.*

	Chester Zoo Infants **Mean** (SD)	PRI Infants **Mean** (SD)
Play type		
Solitary:		
Locomotor	**68** (11)	**84** (11)
Object	**32** (12)	**13** (9)
Other	**0** (0)	**2** (2)
Social:		
Mild contact	**43** (10)	**44** (6)
Rough & Tumble	**17** (8)	**3** (1)
Locomotor	**29** (11)	**27** (13)
Tickle	**5** (4)	**23** (8)
Communication	**3** (2)	**3** (1)
Object	**3** (3)	**<1** (1)

The proportion of social play time spent engaging in communication play did not differ by setting, $f(1,5) = 0.34$, $p = 0.59$, $\eta^2 = 0.06$, neither did the proportion of social play time spent engaging in locomotor play, $F(1,5) = 0.02$, $p = 0.88$, $\eta^2 = 0.01$. The proportion of social play that involved objects was too small to analyse.

C.2. Play Partners

The play partners of chimpanzee infants are reported by group in Table 4.4. Group level means are given because of differences in the composition of the two social groups which meant that juveniles were only present at Chester Zoo and not at PRI. Peer play accounted for the greatest proportion of social play time at both Chester Zoo (M = 53.7) and PRI (M = 49.2). However, there was considerable variation in the amount of time spent playing with peers and peers were not the primary play partners for 3 of the 7 chimpanzee infants. At Chester Zoo, play with juveniles accounted for the second highest proportion of infants' social play time (M = 24.3) with the vast majority of infant-juvenile play intervals involving the 3-year-old juvenile (96%) rather than the 6-year-old. Play with adults or adolescents (M = 12.1) and play with the mother (M = 9.9) accounted for relatively small proportions of play time at Chester Zoo. At PRI, juveniles were not present and greater proportions of infants' social play time were spent with mothers (M = 30.7) and with adults and adolescents (M = 20.1). The mother was the primary play partner for two of the three PRI infants while the other PRI infant was never observed to play with her mother.

Table 4.4. *Play partners for chimpanzee infants at two settings, as mean percentages of social play intervals.*

	Group					
	Chester Zoo			PRI		
Play partner	**M**	Range	SD	**M**	Range	SD
Peer	**53.7**	34 – 70	15.2	**49.2**	32 – 71	19.8
Juvenile	**24.3**	20 - 35	8.3	**-**	-	-
Mother	**9.9**	5 – 22	8.3	**30.7**	0 – 46	26.6
Adult/Adolescent	**12.1**	4 – 26	9.9	**20.1**	10 – 29	9.6

Note. No juveniles were present at PRI. Mean calculations are based on social play intervals where the play partner was visible (98% of intervals).

C.3. Play Type x Play Partner

The types of play with peers versus the types of play with mothers, adults and adolescents were compared (see Table 4.5). Mother play was combined with adult/adolescent play because of missing data from the one infant who was never observed to play with her mother. Paired sample t-tests were used to compare the proportion of each type of social play when playing with peers versus when playing with mothers, adults or adolescents. Two types of play showed significant variation depending on the play partner of the infant. Tickle play accounted for a significantly greater proportion of social play time when infants were playing

with mothers, adults or adolescents (M= 29.6) than when infants they were playing with their peers, $t(6) = 4.33$, $p < .01$. Infants were not observed to engage in tickle play with their peers. Locomotor play accounted for a significantly lower proportion of social play time when infants were playing with their mothers, adults, or adolescents (M = 9.8) than when infant were playing with their peers (M = 39.3), $t(6) = 6.76$, $p < .01$. The play partner had no significant effect on the proportion of social play time that infants spent engaging in contact play, object play, or invite play. Play with juveniles was only observed at Chester Zoo but contact play accounted for a particularly large proportion of play with juveniles (M = 69.8, SD = 6.0) with locomotor play also making up a sizeable proportion of play with juveniles (M = 24.4, SD = 9.9).

Table 4.5: *The types of social play engaged in by chimpanzee infants as a function of play partner.*

	Play partner					
	Peer			Mother / adult / adolescent		
Type of play	**M**	Range	SD	**M**	Range	SD
Social contact[1]	**57.4**	47 – 75	11.3	**54.8**	31 – 92	19.7
Social tickle	**0.0**	0 – 0	0	**29.6**	0 – 49	18.1
Social locomotor	**39.3**	22 – 51	11.5	**9.8**	2 – 20	7.3
Social invite	**2.0**	0 – 7	2.5	**2.9**	1 – 5	1.5
Social object	**1.4**	0 - 7	2.5	**2.9**	0 - 7	3.0

Note. Means are the mean percentage of play intervals with peers and the mean percentage of play intervals with mothers/adults/adolescents.
[1] Social contact play incorporated both social mild contact and social rough and tumble play.

An additional chi-square analysis was conducted to compare rough and tumble play with tickle play for peers, mothers, and other partners (see Table 4.6). A significant chi square, Chi2 (2) = 347.23, $p < 0.001$, indicated that infants engaged in tickle play with peers less often than expected, and less often than expected with other adults or adolescents, but were tickled more often than expected with mothers. Infants engaged in rough and tumble play more often than expected with other infants, and less often than expected with the mother.

Table 4.6: *Chimpanzee infants' time spent in tickle play and rough and tumble play with mothers, peers, and other play partners: A chi-square analysis.*

	Rough and tumble	Tickle
Other	220 (expected 178)	75 (expected 117)
Peer	137 (expected 83)	0 (expected 54)
Mother	5 (expected 102)	164 (expected 67)

C.4. Level of Engagement of Play Partner

When infants were playing with a partner, the partner was fully engaged during an overall average of 66.4% of social play time (SD = 4.3). The rest of the time partners were either partly engaged with the infant's play (M = 17.9, SD = 3.9) or they were not engaged at all and as such were ignoring, avoiding, or discouraging the infant's attempt to play with them (M = 15.3, SD = 2.6). Other types of engagement were rarely observed (M = 0.4, SD = 0.9). Intervals where the level of engagement could not be assessed because of limited visibility of the play partner (9% of social play intervals) were not included in these calculations.

Paired samples t-tests were used to compare peer play partners and mother, adult and adolescent play partners on the proportion of time spent at different levels of engagement with the infant. There were no significant differences at any of the four levels of engagement. Directionally, however, peers were fully engaged during a greater proportion of playful intervals (M = 68.2, SD = 10.0) than mothers, adults, or adolescents (M = 50.2, SD = 21.9).

D. Discussion

The play activities of one-year-old infants from two captive groups were remarkably similar despite differences in group size and experience with humans. Play was mainly solitary rather than social, with solitary play activities accounting for two-thirds of play time on average. A similar pattern was found amongst the infants in Markus and Croft's (1995) study at Taronga Zoo. Although descriptions of chimpanzee play often place greater emphasis on its social aspects, these findings emphasise that solitary play activities should not be ignored particularly when observing chimpanzee infants. Engaging in a variety of solitary and social play types is likely to have a range of beneficial effects, with regards to infants' motor, cognitive and social development.

Solitary locomotor play was the main type of play engaged in by one-year-old chimpanzees and it accounted for around half of infants' play time. All of the chimpanzee infants were observed spending long periods of time climbing and swinging on the climbing frames, ropes, and cargo nets in their enclosures. More acrobatic manoeuvres such as somersaults occurred only occasionally in these

young infants. Infants' motor skills were developing quickly at this age and such play is likely to support their development. Extensive solitary locomotor play may be particularly valuable for one-year-old chimpanzees because they need to become adept at manoeuvring around their environment without relying on their mother being within arms reach. By being able to safely negotiate their environment, they can seek out a variety of play opportunities and escape from any sudden bouts of aggression between group members. From an evolutionary perspective, solitary locomotor play is thought have survival value as the practise of motor skills (general athletic ability) could enhance the ability to fight or flee from danger in later life (Aldis, 1975; Byers & Walker, 1995; Nishida & Inaba, 2009). Nishida and Inaba (2009) recently analysed pirouetting, a type of solitary locomotor play, in order to investigate its possible evolutionary functions. They found no significant sex differences in the developmental progress of pirouetting in infant chimpanzees suggesting that it functions to develop general motor skills during infancy. However, juvenile males spun faster than juvenile females suggesting that pirouetting may also have a sexual selection function by enabling males to have greater success in conflicts with rival males.

Solitary object play accounted for one sixth of all play time, which was comparable to the amount of time spent engaging in social contact play. Chimpanzee infants from both groups engaged in similar amounts of object play despite the PRI infants having additional experience with objects in experimental settings. Although research has generally concluded that objects are of more interest to younger chimpanzees than to older chimpanzees (Markus & Croft, 1995; Takeshita & Walraven, 1996), object play has rarely been studied in chimpanzee infants this young and it is perhaps surprising that objects were such

interesting play things to all of the one-year-olds. Mothers were not observed to encourage object play nor are there any published reports to suggest that mother chimpanzees encourage this behaviour in their young infants. Furthermore, infants only had familiar objects to play with as no novel toys were provided by human caregivers. Common play items included frayed rope ends, the metal clasps used to secure ropes, branches and piles of straw. Infants manipulated these play objects with their hands, feet and mouths; they shook the objects, hit them, or used them to hit other things.

Object play is though to foster general cognitive skills which may support tool use in some species (Bekoff & Byers, 1981). While there was little evidence that the object play of infants in this study was directly related to their later tool use, it may have been helping them to acquire a basic understanding of the properties of objects before they begin to imitate and experiment with tool use. This process of imitation of adult tool use seems to begin around 3 – 4 years (Goodall, 1986b) though chimpanzees infants as young as 21 months are able to copy a human experimeter's actions on objects (Takeshita et al., 2005). Infants in the Chester Zoo group were usually close by when their mothers used branches as tools to dip for food in mock termite holes but no attempts to copy this behaviour were observed. However, on a couple of occasions infants did display a creative use of objects when they used branches to poke at vegetables that had fallen in the shallow moat during the food scatter.

In addition to being a precursor to tool use, solitary object play may be a precursor to the incorporation of objects in social play. In older chimpanzees, objects are often incorporated into play chases and play fights (van Lawick-Goodall, 1968). However, social object play was very rare in these young infants,

being observed on only a handful of occasions each lasting only a few seconds. Young infants may need to develop greater confidence in social interactions (and in locomotion) before incorporating objects into their social play. Solitary object play is a safe way to practise skills such as throwing and hitting things with objects before directing these actions towards others as a way to initiate play.

Social play, though accounting for less play time than solitary play, consisted of a greater variety of activities. Physical contact play accounted for the greatest proportion of social play followed closely by locomotor play. During social contact play, infants would gently hit, pat or grasp another individual. The sustained rough and tumble play which others have described in older infants was not yet evident amongst the one-year-olds in this study. However, more boisterous play was evident when infants played with the three-year-old male. Social locomotor play also consisted of a more basic set of behaviours in one-year olds than is evident in older chimpanzees. Play chases were uncommon and instead social locomotor play mainly consisted of infants climbing alongside another individual. The social nature of the activity was evident in infants' looks towards their play partners, to check on their position. Less frequent types of social play included social object play, as already discussed, tickle play, and play invites, with each accounting for less than 5% of play time. Tickle play was occasionally initiated by mothers or other adults but was a much less distinctive feature of one-year-olds play than it is in early infancy. Social invite play was evident when infants spent several seconds trying to invite peers, juveniles, or adults to play, often by waving their arms and displaying play face expressions. The frequency with which infants initiate play is underestimated in this study as it was only coded separately when there was no other type of play in an interval.

However, its occurrence shows that one-year-old chimpanzees were clearly motivated to engage in social play with individuals other than their mothers and capable of using expressions and gestures in an attempt to initiate such play.

Social play, in general, is thought to be the means by which individuals acquire the social skills that are necessary to support group living. The great variety of social play provides infants with many opportunities to learn about the complexities of social interaction, including understanding hierarchies and good manners. As well as a variety of social play types, social play partners are also varied. One-year-olds are no longer playing mainly with their mothers and instead spend more time playing with peers, juveniles, and adults. All of these individuals react to the infant's playful behaviours in different ways and as such play can easily become overwhelming for infants. At one-year-old, infants are still developing the socio-cognitive skills needed to respond appropriately to the behavioural cues of others and so prolonged bouts of social play may be difficult to maintain. As infants develop these skills over the next couple of years, social play would be expected to rapidly increase as a proportion of total play.

The setting appeared to affect the relative proportion of tickle play compared with rough and tumble play that was found in 1-year-old chimpanzees. More of the social play was tickling at PRI, whereas more rough and tumble play was found at Chester Zoo. The settings varied as a function of daily activities, contact with humans, and probably, more important for social play, the age/sex class of potential play partners. There was a significant relation between play partner and type of physical contact play: rough and tumble play occurred more often with peers whereas tickle play occurred more often with mothers. The presence of juveniles at Chester Zoo, and the greater size of the social group, perhaps

encouraged more rough and tumble play to develop skills that would help infants to handle themselves during boisterous play and group conflicts. The Chester Zoo group appeared to have more boisterous play, often initiated by juveniles, and more minor conflicts than the smaller PRI group, though this has not been tested empirically. Tickling play by mothers at PRI may have been functioning, in part, as a substitute for the rougher play that takes place between juveniles and infants, and in the absence of juveniles at PRI mothers engaged in increased tickle play with their infants. Tickling by mothers was often quite vigorous and prolonged at PRI and it gave the infants the opportunity to engage in rougher types of contact play than engaged in with other infants. Larger samples with more varied social groups are necessary to illuminate the proximate causes of this cross-group difference.

The choice of play partners showed considerable variability between infants but generally infants spent about half of their social play time with peers. Peer play was particularly associated with social locomotor play and this type of play was rarely engaged in with mothers and other adults. Peers were also directionally more likely to be fully engaged in the play activity with the infant while mothers and others adults were more likely to be distracted. Thus, interaction with peers provides infants with a broader range of social play behaviours and responses than they would get from their mothers and adults. Infants must also learn to regulate their behaviours during play with peers in order to prevent their play partner becoming distressed and the subsequent intervention by mothers. Infants behaviour during peer play initially seems to resemble behaviour towards mothers but as infants respond in different ways to mothers the infants gradually develop new behavioural patterns (Savage & Malick, 1977).

Infant-juvenile play accounted for the second highest proportion of social play after peer play, though this was only observed at Chester Zoo and not at PRI where there were no juveniles. Infants often played with the 3-year-old juvenile, Eric, but rarely with the 6-year-old. The significant amount of play between the one-year-old infants and the 3-year-old supports other observations about the preferred age difference between play partners. Play partners tended to differ in age by about a couple of years in Markus and Croft's (1995) study of several infants and juveniles within the same group. At Chester Zoo, Eric was particularly likely to play with his nephew Carlos and their relationship seemed akin to the sibling relationships observed by van-Lawick Goodall (1968). Play between Eric and the infants typically consisted of more boisterous contact play than was evident between infants and peers or adults. Thus the presence of young juveniles may encourage the development of rough and tumble play at an earlier age than when play partners are mainly peers or adults. At PRI, the lack of juveniles was compensated for by more play time with mothers and adults rather than more play time with peers. However, instead of engaging in boisterous play fights, mothers and adults at PRI tended to stimulate their infants with vigorous and prolonged tickling. Given the different types of play encouraged by play partners of different ages, a wide range of play partners is likely be most beneficial to infants social skill development.

In summary, the play of one-year-old chimpanzee infants is characterised by a considerable amount of solitary locomotor play perhaps indicating the importance of rapid motor skill development at this age. Other types of play also occur though in more basic forms than is evident in older infants and juveniles. Thus object play is mainly solitary manipulation of objects with few instances of

objects being incorporated into social play or being used as tools. Likewise, social play involves mainly gentle interactions with little rough and tumble wrestling or chasing. Different play partners seem to have different roles in the socialisation of play. Mothers and adults mainly engage in tickling of the infant and while they tolerate other playful behaviours they are less likely to fully engage in this play. Play with peers enables infants to engage in gentle contact play and locomotor play with a responsive partner while playing with juveniles may gradually increase infants' tolerance of more boisterous play. Overall, play provides a great variety of learning opportunities for infant chimpanzees and as such is much broader in scope than the play fights and chases that characterise the play of adult chimpanzees.

Chapter 5. Joyful expressions of one-year-old chimpanzee infants from two captive settings

A. Introduction

Joy is one of the basic emotional systems in the mammalian brain and thus has a long evolutionary history (Panksepp & Smith-Pasqualini, 2005). Nevertheless, its adaptive value has proved hard to define. Recent theories often compare human smiles and laughter to similar expressions in chimpanzees and other nonhuman primates, highlighting both the evolutionary heritage of these expressions and their development into human forms and contexts (Caron, 2002; Gervais & Wilson, 2005; Owren & Bachorowski, 2003; Provine, 2000; Weisfeld, 1993). However, while much has been written about the form of chimpanzee joyful expressions and their communicative value during social play, there have been few studies that explore the specific contexts of joy and even fewer that consider the contexts of joy during chimpanzee infancy, when playfulness is at its peak.

Chimpanzee play is punctuated by various facial, vocal, and motor expressions, the most researched of which is the play face. The chimpanzee play face is characterised by a relaxed open mouth with the teeth either completely covered by the lips or exposed to varying degrees (Parr, Preuschoft, & de Waal, 2002; van Hooff, 1973; van Lawick-Goodall, 1968). The most intense play faces expose both the upper and lower teeth, though not the gums, and have been observed during very boisterous play fighting and tickling (van Lawick-Goodall,

1968, 1972). Play faces emerge spontaneously by 11 days of age on average (Bard, 2003) and can be a response to gentle tickling or familiar sights or sounds. Play faces appear in wider variety of contexts as infants develop a broader repertoire of play (Bard, 2003; van Lawick-Goodall, 1968). Play faces are sometimes accompanied by laughter-like vocalisations which sound like soft panting breaths or grunts (Davila Ross, Owren, & Zimmermann, 2010; van Hooff, 1972). Laughter, as with play faces, emerges during the first few weeks of life in response to tickling by mothers and later seems to occur in chase play and during rougher wrestling play (Bard, 1996; van Lawick-Goodall, 1968; Vettin & Todt, 2005). Motor expressions can also indicate playfulness and joy in chimpanzees. Various rotational movements (somersaults, rolls, and spins, for example) occur in playful contexts without any obvious purpose as do exaggerated jumps and flailing of arms and leg (Aldis, 1975; Nishida & Inaba, 2009). Other motor expressions – the tickle request gesture and the play walk – appear to be ritualised means of initiating play with others. The tickle request gesture, characterised by arms reaching backwards over the shoulders, first appears developmentally as a defence mechanism during tickling and later becomes a way for infants to request tickling from mothers (Plooij, 1978, 1979). The play walk, which may not appear until late infancy, is characterised by the chimpanzee walking or gambolling towards a play partner with a rounded back and swaying motion (Goodall, 1986b). Another group of motor expressions, including hitting and stamping, are not exclusive to play and can also be found in more aggressive contexts (van Hooff, 1973; van Lawick-Goodall, 1968).

Studies of chimpanzees' joyful expressions have typically concentrated on social contexts, driven by an interest in their communicative function. One of the

first empirical analysis of the contexts of play faces was conducted by van Hooff (1973). From observations of social encounters amongst a captive chimpanzee colony, he found that play faces were associated with play fighting and gymnastic displays but were not associated with aggression, grooming, submission or excitement. Chimpanzee laughter is also associated with particular types of play fighting. Vettin and Todd (2005) found that laughter occurred at a higher rate during wrestling and tickling than during grabbing and chasing. Joyful motor expressions were studied as part of a longitudinal study of chimpanzee gestural communication by Tomasello, Call, Nagell, Olguin, and Carpenter (1994). Certain gestures were common during infants' social play including raised arms, ground slaps, foot stomps, pokes, head bobs, hand claps and throwing stuff. Motor expressions sometimes appeared to function as a way to gain another's visual attention, thus allowing them to notice a play face and recognise that the individual was inviting them to play. Although these studies were restricted to social contexts, there are anecdotal observations of joyful expressions during solitary play (e.g. Goodall, 1986b; Hirata, Yamakosh, Fujita, Ohashi, & Matsuzawa, 2001; Power, 2000).

The effect of play faces on the social behaviour of play partners and third parties has been explored in recent studies. Waller and Dunbar (2005) explored the behavioural consequences of play faces in social contexts in another captive chimpanzee colony. Social play behaviours significantly increased following production of a play face, even though play faces were not necessary for play to occur. Furthermore, play bouts were longer when both play partners produced play faces. Thus play faces may be encouraging others to engage in play by signalling that behaviours are intended to be playful rather than aggressive. Flack,

Jeannotte, and De Waal (2004) found that the play faces and laughter expressions of juveniles may also be signalling to mothers that behaviours are playful therefore stopping them from intervening. This was evident from the increase in play faces and laughter between play partners when the mother of the younger play partner was nearby.

The focus on chimpanzees' social play in the above studies of joyful expressions may be appropriate for chimpanzees after infancy when their play typically consists of play fighting and chasing. However, solitary play is the predominant type of play during chimpanzee infancy (Markus & Croft, 1995). In one-year-old chimpanzee infants, solitary activities, such as locomotor play and object play, account for two-thirds of the time spent playing, while play fighting only appears in immature and rather hesitant forms (see Chapter 4). Therefore, the study of joyful expressions in infancy is incomplete without considering their occurrence in a variety of social and solitary contexts. A recent study of play faces in wild chimpanzee infants and juveniles confirmed that object play can be a source of enjoyment to young chimpanzees: play faces were observed during 7% of intervals where infants and juveniles were engaged in object manipulation activities. However, Ramsey and McGrew did not distinguish between social and solitary object manipulation and further research is required to understand how the rate of occurrence of joyful expressions during object play compares to other contexts. Joyful emotions are thought to have a role in expanding creativity and aiding in skill development (Fredrickson, 2003) and therefore it is interesting to consider their occurrence in different contexts during infant development. The findings from such research will also help to address questions about the degree to

which these expressions function as social signals rather than simply as expressions of an individual's emotional state.

The purpose of this study was to explore the playful contexts of joyful expressions in one-year-old chimpanzee infants in two captive chimpanzee settings. The rate of occurrence of infant joy was examined across a range of social and solitary play types. In addition, certain social factors related to play partners – their ages and relationships to infants, their level of engagement with infant play, their matching of infant joyful expressions - were also examined to understand their influence on chimpanzee infant joy. Facial joy (play faces) and motor joy were included in the analyses. However, it was not possible to collect laughter vocalisations due to plexiglass-encased displays at Chester Zoo and a great distance between the observers and the subjects at PRI.

B. Method

B.1. Participants

Chimpanzee infants were observed at two captive settings, Chester Zoo (n = 4) and PRI (n = 3). (See Chapter 4 for full details of the infants, their mothers, and the social groups at each setting)

B.2. Procedure

The procedure is described in Chapter 4.

B.3. Coding System

There were six levels to the coding scheme: play, play type, play partner, level of engagement of the play partner, infant joy, and matching infant joy (see Appendix A for full details of the codes). The process of coding the first four levels of the coding scheme is described in Chapter 4. For this study, infant joy and matching infant joy were also coded in five-second intervals using INTERACT coding software (Mangold, 2006).

All intervals of social and solitary play (n = 7531), as identified by the *play type* coding scheme, were analysed for *infant joy.* Each of these intervals was analysed to determine the presence or absence of infant *facial joy* and the presence or absence of infant *motor joy*. All intervals containing both social play and infant joy (n = 929) were coded for *matching infant joy*. Each of these intervals with facial joy (n = 677) was analysed to determine the presence or absence of facial joy by the play partner (*matching facial joy*). Similarly, each of these intervals with motor joy (n = 386) was analysed to determine the presence or absence of motor joy by the play partner (*matching motor joy*).

B.4. Reliability

Reliability of *play, play type, level of engagement of play partner* and *play partner* is detailed in Chapter 4. Reliability of *infant joy* and *matching infant joy* was tested by the third coder on a minimum of 12% of relevant intervals. Observed agreement and Cohen's kappa scores were as follows: *infant joy* (facial: 87%, 0.79; motor: 94%, 0.85); and *matching infant joy* (facial: 88%, 0.82; motor: 93%, 0.85). Therefore, there was good reliability.

C. Results

Infant joy was recorded during 1298 playful intervals, with facial joy in 820 intervals and motor joy in 807 intervals. Infant joy is reported as mean intervals per minute (ipm) across a range of play contexts, thus factoring out variation in the amount of time observed in different contexts. The mean ipm is the average across the infants, thus controlling for differences in the amount of joyful expressions observed for each infant. The maximum possible rate of joy is 12 ipm because play was coded in 5-second intervals. Joyful expressions are reported as rates rather than as percentages in line with similar research by Adamson and Bakeman (1985) which reported the mean rate of positive affective expressions per minute of infant play. The mean rates of overall joy and facial joy was calculated after excluding playful intervals where the face was not visible (32% of playful intervals). The mean rates of motor joy were based on all playful intervals as visibility of the body was excellent. Some descriptive statistics of the observations are included and are reported as mean percentages of playful intervals to distinguish them from the rate calculations.

The chimpanzee infants are treated as one group for the majority of the results section. Comparisons between the two settings, Chester Zoo and PRI, were conducted and revealed many similarities. Therefore, only significant differences between the two settings are mentioned. Non-parametric Mann-Whitney U tests were used for comparisons between settings because of the small numbers of infants per setting. However, parametric tests were preferred for analyses of the total sample. An alpha level of 0.05 was used for all statistical tests.

C.1. Infant Joy

The mean rate of infant joy during play was 3.0 ipm (SD = 0.8). The rate of facial joy was 2.0 ipm (SD = 0.9) while the rate of motor joy was 1.4 ipm (SD = 0.3). The rates of facial joy and motor joy were compared using a paired samples t-test and there was no significant difference, $t(6) = 1.89$, $p = .11$. Facial joy and motor joy occurred together in 12.8 % (SD = 5.7) of joyful intervals on average. However, as the overlap between these modalities was relatively small, it was not analysed further.

C.2. Infant Joy by Social versus Solitary Play

Nearly two-thirds of all intervals with infant joy occurred during social play (see Table 5.1). This was despite social play accounting for only one-third of playful intervals (see Chapter 4). Facial joy was particularly skewed towards social play with 84% of intervals occurring during social play compared to only 45% of the intervals of motor joy.

Table 5.1: *The distribution of chimpanzee infants' joyful expressions and playful intervals across social and solitary play.*

	% of joyful intervals						% of playful intervals	
	Any joy		Facial joy		Motor joy			
Play type	M	SD	M	SD	M	SD	M	SD
Social	**65**	9	**84**	7	**45**	10	**34**	6
Solitary	**35**	9	**16**	7	**55**	10	**66**	6

Note. Mean scores are the mean percentage of joyful intervals by type of play and the mean percentage of playful intervals by type of play.

The mean rates of infant joy during social play and solitary play are shown in Table 5.2. Overall, the mean rate of joy was 3.6 times higher during social play than during solitary play. The difference between social and solitary play was particularly marked for facial joy, with the mean rate being 9.8 times higher during social play than during solitary play. Motor joy also occurred at a higher rate during social play than during solitary play, though at 1.7 times higher the difference was less marked. Paired sample t-tests comparing the mean rates of infant joy during social and solitary play found significantly higher rates during social play: any joy, $t(6) = 9.00$, $p < .01$; facial joy, $t(6) = 7.36$, $p < .01$; motor joy, $t(6) = 3.13$, $p = .02$. Comparison between the mean rates of facial joy and the mean rates of motor joy during social play and during solitary play also found significant differences. During social play, facial joy occurred at a significantly higher rate than motor joy, $t(6) = 4.02$, $p < .01$, whereas during solitary play, motor joy occurred at a significantly higher rate than facial joy, $t(6) = 6.37$, $p < .01$.

Table 5.2: *Chimpanzee infants' mean rate of joy during social play and during solitary play.*

Type of play	Rate of joyful intervals per minute					
	Any joy		Play faces		Motor joy	
	M	SD	M	SD	M	SD
Social	**5.8**	1.5	**4.7**	1.8	**1.9**	0.6
Solitary	**1.6**	0.4	**0.5**	0.3	**1.1**	0.3

C.3. Infant Joy by Play Type

Joyful expressions occurred across a range of social and solitary play types (see Table 5.3). Social contact play was the most likely context for joy, and facial joy in particular, with 37% of all joyful expressions and 50% of play faces occurring in this context. This was despite social contact play accounting for a much lower proportion of playful intervals than solitary locomotor play. However, solitary locomotor play was the most likely context for motor joy, with 37% of instances of motor joy occurring in this context. The Chester Zoo and PRI groups differed in the percentage of facial joy occurring in social contact and social tickle play, though not in any other type of play. Mann-Whitney U tests found that social contact play accounted for a higher percentage of facial joy at Chester Zoo (M = 59%, SD = 11) than at PRI (M = 38%, SD = 8), U = 0.00, p = .03. However, social tickle play accounted for a lower percentage of facial joy at Chester Zoo (M = 9, SD = 11) than at PRI (M = 36, SD = 9), U = 0.00, p = .03.

Table 5.3: *The distribution of chimpanzee infants' joyful expressions and playful intervals across a range of social and solitary play types.*

	% of joyful intervals						% of playful intervals	
	Any joy		Facial joy		Motor joy			
Play type	**M**	SD	**M**	SD	**M**	SD	**M**	SD
Social:								
Contact	**37**	8	**50**	14	**25**	9	**18**	5
Tickle	**15**	12	**20**	17	**7**	7	**4**	3
Locomotor	**8**	5	**10**	6	**6**	4	**9**	4
Invite	**4**	2	**3**	3	**6**	2	**1**	0
Object	**1**	1	**1**	2	**0**	0	**1**	1
Solitary:								
Locomotor	**22**	7	**8**	3	**37**	15	**50**	8
Object	**11**	8	**6**	6	**15**	9	**16**	10
Other	**2**	4	**2**	5	**2**	5	**1**	1

Note. Mean scores are the mean percentage of all joyful intervals that occurred during each type of play and the mean percentage of all playful intervals that were classified as each type of play.

The mean rate of infant joy per minute of different types of social and solitary play is shown in Table 5.4. Rates were calculated for five play types - social tickle, social contact, social locomotor, solitary locomotor, and solitary object. One infant was never observed to engage in social tickle play so the rate of joyful expressions during this type of play was based on an average of six infants. Mean rates of joy could not be accurately determined for the other types of play –

social object, social invite, and solitary other – because they accounted for very small proportions of playful intervals. One-way repeated measures ANOVAs were used to compare the rates of any joy, facial joy, and motor joy across the five different play types. The mean rate of joy was significantly different across play types, $F(4,20) = 49.68$, $p < .01$, $\eta^2 = .91$. Repeated planned contrasts showed that the rate was significantly higher during social tickle play than during social contact play, $F(1,5) = 12.65$, $p = .02$, $\eta^2 = .72$, and significantly higher during social contact play than during social locomotor play, $F(1, 5) = 81.61$, $p < .01$, $\eta^2 = .94$. However, the rate of joy did not differ significantly between social locomotor play and solitary object play, $F(1,5) = 1.29$, $p = .31$, $\eta^2 = .20$, nor between solitary object play and solitary locomotor play, $F(1,5) = 3.57$, $p = .12$, $\eta^2 = .42$. The same pattern was found for facial joy and motor joy. The mean rate of facial joy was significantly different across play types $F(4,20) = 88.78$, $p < .01$, $\eta^2 = .92$. Repeated planned contrasts showed that the rate was significantly higher during social tickle play than during social contact play, $F(1,5) = 19.85$, $p < .01$, $\eta^2 = .80$, and significantly higher during social contact play than during social locomotor play, $F(1,5) = 39.46$, $p < .01$, $\eta^2 = .89$. However, the rate of facial joy did not differ significantly between social locomotor play and solitary object play, $F(1,5) = 3.32$, $p = .13$, $\eta^2 = .40$, nor between solitary object play and solitary locomotor play, $F(1,5) = 1.60$, $p = .26$, $\eta^2 = .24$. The rate of motor joy was significantly different across play types, $F(4,20) = 1.78$, $p = .02$, $\eta^2 = .44$. Repeated planned contrasts showed that the rate was higher during social contact play than during social locomotor play though at only marginal significance, $F(1,5) = 5.06$, $p = .07$, $\eta^2 = .50$. However, the rate of motor joy did not differ significantly between social tickle play and social contact play, $F(1,5) = 1.78$, $p =$

.24, $\eta^2 = .26$, between social locomotor play and solitary object play, F (1,5) = 1.20, p = .32, $\eta^2 = .19$, nor between solitary object play and solitary locomotor play, F(1,5) = 0.98, p = .37, $\eta^2 = .16$. To summarise, social tickle play and social contact play featured higher rates of overall joy and facial joy than other types of social and solitary play. Social contact play also featured a higher rate of motor joy than other types of play though the difference was only marginally significant.

Table 5.4: *Chimpanzee infants' mean rate of joyful expression during different types of play.*

	Rate of joyful intervals per minute					
	Any joy		Facial joy		Motor joy	
Play type	**M**	SD	**M**	SD	**M**	SD
Social tickle[a]	**9.5**	2.1	**9.0**	2.1	**2.5**	1.6
Social contact	**6.0**	1.4	**4.9**	1.7	**1.9**	0.5
Social locomotor	**2.7**	1.4	**2.1**	1.5	**0.9**	0.6
Solitary object	**2.1**	0.7	**0.8**	0.7	**1.3**	0.5
Solitary locomotor	**1.4**	0.5	**0.4**	0.3	**1.0**	0.3

[a]The rates of joyful expression during social tickle play are based on n = 6 because one infant was never observed to engage in this type of play.

C.4. Infant Joy by Play Partner

Infant joy occurred with a variety of different play partners at both settings, though juveniles were only present at Chester Zoo. The distribution of all joyful expressions by setting across a range of play partners is shown in Table

5.5. At Chester Zoo, nearly two thirds of facial joy expressions occurred during play with peers or juveniles (36% with peers, 26% with juveniles). However, at PRI, nearly two thirds of facial joy expressions occurred with adults (43% with mothers, 20% with other adults or adolescents). Over half of all instances of motor joy occurred during solitary play. However, when play was social, motor joy at Chester Zoo occurred most often during peer play while motor joy at PRI was spread more evenly across a range of partners at PRI.

Mean rates of joy per minute of play with different play partners are shown in Table 5.6. The results are not reported by setting because Mann-Whitney U tests found no significant differences between settings in the rates of joy with different play partners. The rate of joy with mothers was combined with the rate of joy with adults and adolescents because one infant was never observed playing with her mother. Combining these play partners into one category allowed the sample size to remain at N = 7 for the statistical analyses. The mean rates of any joy, facial joy, and motor joy were higher during play with mothers, adults, and adolescents than during play with peers. Paired samples t-tests confirmed that these differences were significant: any joy, $t(6) = 3.56$, $p = .01$; facial joy, $t(6) = 2.61$, $p = .04$; motor joy, $t(6) = 2.85$, $p = .03$. The mean rate of joyful expression during play with juveniles could only be calculated for the Chester Zoo sample where the rate appeared to lie above that for peer play and below that for mother, adult and adolescent play.

Table 5.5: The distribution of ch*impanzee infants' joyful expressions and playful intervals across a range of play partners, for Chester Zoo and PRI infants.*

	% of joyful intervals						% of playful intervals	
	Any joy		Play faces		Motor joy			
Play partner	M	SD	M	SD	M	SD	M	SD
			Chester Zoo					
Peer	**26**	8	**36**	15	**20**	9	**17**	5
Juvenile	**16**	8	**26**	8	**8**	3	**8**	4
Mother	**8**	11	**12**	18	**7**	8	**3**	3
Adult/adolescent	**8**	6	**8**	10	**7**	4	**4**	4
Partner unknown	**3**	2	**1**	1	**4**	3	**1**	0
No partner	**39**	11	**17**	7	**55**	13	**66**	8
			PRI					
Peer	**22**	15	**24**	15	**16**	11	**17**	9
Juvenile	**-**	-	**-**	-	**-**	-	**-**	-
Mother	**32**	28	**43**	39	**16**	16	**10**	8
Adult/adolescent	**16**	18	**20**	26	**13**	4	**7**	4
Partner unknown	**0**	1	**0**	0	**1**	1	**0**	0
No partner	**30**	4	**13**	6	**55**	8	**66**	5

Note. There were no juveniles at PRI.

Table 5.6: *Chimpanzee infants' mean rate of joyful expressions during play with different partners.*

	Rate of joyful intervals per minute					
	Any joy		Facial joy		Motor joy	
Play partner	**M**	SD	**M**	SD	**M**	SD
Peer	**4.2**	1.0	**3.2**	1.2	**1.4**	0.5
Mother, adult, or adolescent	**7.2**	2.4	**5.9**	3.2	**2.5**	1.0
Juvenile[a]	**5.9**	2.2	**5.4**	2.2	**1.5**	04

[a] The rate of joyful expressions during play with juveniles could only be calculated for the Chester Zoo infants because there were no juveniles at PRI.

C.5. Infant Joy by Play Partners' Level of Engagement

The distribution of infants' social expressions of joy as a function of play partners' level of engagement is shown in Table 5.7. During social play, over two-thirds of facial expressions of joy occurred when infants were playing with a fully engaged play partner. However, motor expressions of joy were less biased towards fully engaged play partners and about a half of all motor expressions of joy during social play occurred with play partners who had lower levels of engagement in the playful activity.

Table 5.7: *The distribution of chimpanzee infants' social expressions of joy by level of engagement of the play partner.*

	% of joyful intervals						% of social play intervals	
	Any joy		Facial joy		Motor joy			
Play partner's level of engagement	M	SD	M	SD	M	SD	**M**	SD
Fully engaged	**66**	7	**71**	6	**53**	8	**67**	5
Partly engaged	**22**	5	**21**	6	**25**	7	**18**	4
Not engaged	**12**	7	**8**	5	**22**	8	**15**	3

Note. Mean scores are the mean percentage of joyful intervals during social play by level of play partner engagement and the mean percentage of social play intervals by level of play partner engagement.

The effect of play partners' level of engagement on the mean rate of infant joy is shown in Table 5.8. Overall, the rate of joy was slightly lower when play partners were not engaged compared to when play partners were fully or partly engaged. However, a one-way repeated measures ANOVA found no significant variation across the three levels of engagement, $F(2,12) = 0.51$, $p = .61$, $\eta^2 = .08$. The rate of facial joy was lower when play partners were not engaged compared to when play partners were fully or partly engaged and there was significant variation across levels of engagement, $F(2,12) = 7.43$, $p < .01$, $\eta^2 = .55$. Simple planned contrasts showed that the rate of facial joy was significantly lower when the partner was not engaged than when the partner was either fully engaged, $F(1,6) = 12.72$, $p = .01$, $\eta^2 = .68$, or partly engaged, $F(1.6) = 9.73$, $p = .02$, $\eta^2 = .62$. The pattern was different for motor joy with the rate being lower when play partners were fully engaged than when they were partly engaged or not engaged.

This variation across levels of engagement was marginally significant after correcting for a violation of sphericity, Greenhouse-Geisser $F(1.11,6.68) = 4.93$, $p = .06$, $\eta^2 = .45$. Simple planned contrasts showed that the rate of motor joy was significantly lower when the partner was fully engaged than when the partner was either partly engaged, $F(1,6) = 43.24$, $p < .01$, $\eta^2 = .88$, or not engaged, $F(1.6) = 6.18$, $p = .05$, $\eta^2 = .51$.

Table 5.8: *Chimpanzee infants mean rate of joyful expression by level of engagement of play partner*

	Rate of joyful intervals per minute					
	Any joy		Facial joy		Motor joy	
Play partners' level of engagement	**M**	SD	**M**	SD	**M**	SD
Fully engaged	**5.7**	1.5	**5.1**	1.8	**1.3**	0.2
Partly engaged	**5.7**	1.6	**5.1**	2.2	**2.4**	0.5
Not engaged	**4.7**	2.9	**2.7**	1.9	**2.8**	1.7

C.6. Matching Infant Joy

There were 684 intervals of social play where infants expressed joy and where the expression of the play partner could be assessed. For facial joy, there were 424 intervals where the play partner's face was visible. For motor joy, there were 335 intervals where the play partner's body was visible. Intervals with no visibility of the play partner were excluded from all calculations (26% of intervals with any joy, 37% of intervals with facial joy, and 13% of intervals with motor

joy). Matching of infant joy is reported as the mean percentage of infant joy intervals during social play that include an expression of joy by the play partner within the same interval. Expressions of joy had to be in the same modality in both the infant and the partner to be classed as sharing.

Infants' joyful expressions were matched by play partners in 29% of social play intervals (SD = 13). A higher percentage of infants' joyful expressions were matched by play partners at Chester Zoo (M = 38%, SD = 6) than by play partners at PRI (M = 18%, SD = 10), Mann-Whitney U = 0.00, p = 0.03. Facial joy was directionally more likely to be matched than motor joy: 36% (SD = 28) of facial expressions matched by partners compared to 21% (SD = 6) of motor expressions. However, a paired samples t-test found that the difference between matching facial joy and matching motor joy was not significant, t(6) = 1.26, p = .26. Play partners at Chester Zoo matched infants' facial joy in a significantly higher percentage of intervals than did play partners at PRI (Chester Zoo: M = 55%, SD = 19; PRI: M = 11%, SD = 11), Mann-Whitney U = 0.00, p = .03. There was no significant differences by setting in matching motor joy, U = 3.00, p = .29.

In the following sections, matching infant joy is considered by type of social play, by play partner, and by level of engagement of the play partner. The results are reported for the total group rather than by setting. The higher incidence of facial joy matching at Chester Zoo is acknowledged. However, comparisons of the settings across play contexts would have been on relatively small subsets of the total observations with reduced accuracy.

C.7. Matching Infant Joy by Type of Social Play

The percentage of infants' joyful expressions during social play that were matched by play partners was compared for social contact play versus other types of social play (see Table 5.9). The category of other social play combined locomotor, tickle, invite and object play because individually these play types accounted for relatively few intervals where infants displayed joyful expressions. Overall, matching of joyful expressions did not vary significantly between social contact play and all other social play, $t(6) = 1.24$, $p = .26$. However, facial joy was matched in a higher proportion of intervals of social contact play than in intervals of other social play, $t(6) = 3.33$, $p = .02$. During social contact play, 45% of infants' facial expressions of joy were matched by partners compared to only 16% during other social play. In contrast, motor joy was matched in a lower proportion of intervals of social contact play than in intervals of other social play, $t(6) = 2.39$, $p = .05$, though the significance level just missed being less than .05. During social contact play, 14% of infants' expressions of motor joy were matched by partners compared to 34% during other social play.

Table 5.9: *The mean percentage of chimpanzee infants' joyful expressions that were matched by play partners during two different types of play.*

	% of joyful intervals matched by play partners					
	Any joy		Facial joy		Motor joy	
Play type	**M**	SD	**M**	SD	**M**	SD
Social contact	**32**	17	**45**	31	**14**	11
Other social	**25**	10	**16**	18	**34**	13

C.8. Matching Infant Joy by Play Partner

The percentage of infants' joyful expressions that were matched by peers and by mothers, adults and adolescents was compared (see Table 5.10). Overall, peers matched 31% of infants' joyful expressions while mothers, adults and adolescents matched only 14%. This difference was significant, $t(6) = 2.49$, $p = .047$. Peers also matched a greater percentage of infant's facial expressions of joy than were matched by mothers, adults, or adolescents, $t(5) = 3.87$, $p = .01$. However, there was no significant difference in the percentage of expressions of motor joy that were matched by peers and the percentage matched by mothers, adults and adolescents, $t(6) = 0.739$, $p = .49$. Juveniles were only present at Chester Zoo and, directionally, they matched a higher percentage of any joyful expressions, facial expressions and motor expressions than other partners.

Table 5.10: *The mean percentage of chimpanzee infants' joyful expressions that were matched during play with different play partners.*

	% of joyful intervals matched by play partners					
	Any joy		Facial joy		Motor joy	
Play partner	**M**	SD	**M**	SD	**M**	SD
Peer	**31**	13	**45**	20	**13**	11
Mother, adult, adolescent[a]	**14**	10	**10**	12	**19**	13
Juvenile[b]	**65**	8	**81**	15	**35**	22

[a] One of the Chester Zoo chimpanzees never produced any facial joy with her mother or any adults or adolescents. Therefore, the mean percentage of facial expressions that were matched by mothers, adults, and adolescents is based on n = 6.

[b] Juvenile play partners were only present at Chester Zoo.

C.9. Matching Infant Joy by Level of Engagement of Play Partner

The percentage of infants' joyful expressions that were matched by play partners with different levels of engagement is shown in Table 5.11. Only a small percentage of infants' joyful expressions, of any modality, were matched when play partners were not engaging with infants. When play partners were fully engaged with the infant, infant joy was matched in 40% of intervals. However, matching was lower when play partners were partly engaged and it occurred in 19% of intervals. The difference in matching between fully engaged and partly engaged play partners was significant, $t(6) = 3.74$, $p < .01$. Infants' expressions of motor joy were matched in a higher percentage of intervals when play partners were fully engaged than when they were partly engaged, $t(6) = 4.85$, $p < .01$.

However, there was no significant difference in facial joy matching across these two levels of engagement with infants' facial expressions being just as likely to be matched by partly engaged play partners as they were by fully engaged play partners, $t(6) = 0.59$, $p = .58$.

Table 5.11: *The mean percentage of chimpanzee infants' joyful expressions that were matched by play partners with different levels of engagement.*

	% of joyful intervals matched by play partners					
	Any joy		Play faces		Motor joy	
Level of engagement of play partner	**M**	SD	**M**	SD	**M**	SD
Fully engaged	**40**	16	**39**	28	**39**	14
Partly engaged	**19**	17	**35**	37	**6**	7
Not engaged	**4**	6	**10**	12	**2**	3

D. Discussion

One-year-old chimpanzee infants from two settings produced joyful expressions in a similar variety of play contexts and at similar rates, though there were significant variations in the rate of joyful expressions across different play contexts. Some differences by setting were also evident.

Two different modalities of joyful expression – facial and motor – were analysed (vocal expressions were too quiet to be picked up by the recording equipment) and they occurred at very similar rates across play as a whole and were present in all types of social and solitary play. The rates of facial and motor joy were higher during social play than during solitary play, with the difference particularly marked for facial joy (10 times higher during social play). Motor joy

was less biased towards social play (though rate was 2 times higher during social play), and motor joy occurred at a higher rate than facial joy during solitary play. There were also differences in the specific social contexts of facial and motor joy with motor joy occurring at a higher rate when play partners were not fully engaging with the infant and facial joy occurring at a higher rate when play partners were fully engaging with the infant. Furthermore, joy was more likely to be expressed through one modality (in a 5-second interval) rather than via both modalities, and intervals containing both facial and motor joy accounted for only an eighth of all intervals of infant joy. Taken together, these findings suggest that facial joy and motor joy may have different functions in the communication of emotion. Facial joy is a particular feature of social interactions between infants and a positively engaged play partner whereas motor joy is a feature of solitary play and social interactions between infants and less engaged play partners. Thus, close facial attention between play partners seems to encourage facial expressions of joy whereas when play is solitary or play partners are less attentive motor expressions of joy are more evident. Motor expressions may be more effective than facial expressions at communicating joy when others are at some distance either physically, such as when infants are engaged in solitary play, or mentally, such as when they are not engaging with an infant's desire to play. During solitary play, there were no indications that the infants were deliberately directing their motor expressions of joy (or indeed their facial expressions of joy) towards any particular individual either on or off camera. However, joyful expressions may have adaptive value by communicating to mothers and other family members that the infant is happy thus allowing play to continue without intervention. The conclusions regarding the function of solitary expressions of joy are limited by

the fact that the videos were closely centred on the infants and so it was not possible to measure the influence of factors such as the proximity and visual attention of other individuals on the expression of joy during solitary play. Motor expressions of joy during social play often consisted of playful hitting and seemed to be used by infants as an attention-getting measure to encourage or prolong play. The attention-getting nature of such tactile motor expressions has been reported in studies of gestural communication in young chimpanzees (Liebal, Call, & Tomasello, 2004; Tomasello, Call, Nagell, Olguin, & Carpenter, 1994). At around one-year-old chimpanzee infants' gestural communication seems to be relatively immature, with playful hitting perhaps communicating only the emotional state of the infant and the desire to play. In older infants and juveniles there is greater evidence that such expressions or gestures may be functioning as intentionally- produced communicative devices because they are accompanied by response-waiting and gaze-alternating behaviours (Tomasello et al., 1985; Tomasello, Gust, & Frost, 1989).

The majority of infant play was solitary (either locomotor, 50%, or object, 16%) though the rate of joy during these types of play was relatively low compared to rates during social play. When joy did occur during solitary play, it appeared to coincide with mastery of an acrobatic manoeuvre (such as a tumble, swing, or spin) or successful manipulation of an object (such as getting a rope to swing backwards and forwards). Human infants have also been observed to display facial joy in response to mastery of locomotor skills (Mayes & Zigler, 1992). Explorative activities (of the familiar enclosure and of familiar objects such as ropes and twigs) did not seem to result in many joyful expressions and novel toys were not supplied to the captive chimpanzees. It may be expected that

wild chimpanzee infants have more opportunity for joy during solitary explorative activities than the captive chimpanzee infants because of greater novelty in the forest environment. However, Ramsey and McGrew's (2005) study of object manipulation in wild chimpanzees infants found that play faces and laughter occurred during 7% of all object manipulation activities which is very similar to the rate of facial joy found in this study during solitary object play (0.8 per 12 intervals, i.e. 7% of intervals).

The highest rates of chimpanzee infant joy occurred during play involving close physical contact (social tickle play and social contact play). The rate of infant joy was particularly high during social tickle play but this type of play only accounted for 4% of play time. Social contact play, a mild version of the rough and tumble play found in older chimpanzees, accounted for around a fifth of play time. Rates of facial joy and motor joy were highest during these two types of play than during other types of play. However, the precise nature of facial expressions and motor expressions appeared to differ between the two contexts (though further analysis of onset and offset of expressions and the muscular movements involved is required). Facial expressions of joy during tickle play appeared to be more prolonged with wider, more relaxed mouths whereas during contact play expressions were briefer, mouths were narrower, and play faces sometimes merged into more fearful expressions with greater exposure of the teeth and gums. Tickle play was a familiar type of play started by mothers when their infants were days old with infants responding with play faces by their third week (Bard, in press). Contact play (play fighting) has greater potential for misunderstanding and aggression and infants were tentative in their engagement in this type of play. Motor expressions of joy during tickle play often involved

infants raising their hands over their heads in a tickle request gesture whereas motor expressions during contact play involved were more likely to involve playful hitting, waving arms, or jumping. Chimpanzees have been reported to use motor gestures as attention-getting measures to get play partners to look at their play faces (Tomasello, Gust, & Frost, 1989). These findings with infants suggest that the differentiation in form of facial joy and motor joy across contexts deserves greater research attention to fully understand their functions.

Mothers and other adults were very effective at eliciting infant joy and the rates of facial and motor joy were nearly two times higher than with peers. This was the case for both settings although the PRI infants spent a larger proportion of their play time engaged with mothers and adults in tickle play while the Chester Zoo infants spent a larger proportion of their play time engaged with peers and juveniles in contact play (see Chapter 4). Therefore, at PRI nearly two-thirds of infants' facial expressions of joy were with mothers or adults, whereas at Chester Zoo nearly two-thirds of infants' facial expressions of joy were with peers or juveniles. At Chester Zoo, the presence of two juveniles (absent at PRI) seemed to encourage a greater frequency of contact play as well as rougher forms of contact play between peers. The larger group size at Chester Zoo also seemed to result in a greater frequency of minor conflicts and therefore it may have been more important for infants to practise mild forms of rough and tumble play at an earlier age than was necessary at PRI. Therefore, environmental differences between the groups, in terms of group composition, seem to be influencing the emotional development of infant chimpanzees.

Play partners matched about a third of infants' expressions of joy during social play. However, there were significant variations by play contexts: peers

matched infant joy more often than mothers; facial joy was matched more than motor joy; facial joy was matched more often during contact play than during other social play; motor joy was matched more often during other social play than during contact play; facial joy was matched more often at Chester Zoo than at PRI. Taken together these findings show that matching infant facial joy is a particular feature of social contact play which is typically with peers, and it is probably functioning to reassure the play partners that intentions are playful rather than agnostic. Other studies with different species have also found that play faces are exchanged more often during contact play than during social locomotor play (Canids: Bekoff, 1995; Macaques: Preuschoft, 1992). The high rate of infant facial joy and facial joy matching during contact play supports the popular theory that play faces act as intentional signals, which function to disambiguate potentially agnostic behaviours, such as hitting and wrestling, during play fighting (Flack, Jeannotte, & De Waal, 2004). However, others have questioned the usefulness of play faces during contact play. For example, Aldis (1975) questioned the effectiveness of play faces, as during play fighting play partners often cannot see each other's face, and suggested they may be a prelude to mouthing rather than a signal. Also, Pellis and Pellis (1996) reviewed the role of play signals during play fighting and concluded that while play faces may sometimes act as signals of playful versus non-playful intentions, the broader context is more valuable in determining the likely intentions of others. My observations suggest that infants were often turning to look at each other when displaying play faces during contact play though further analysis of the videos is necessary to explore this issue. Matching occurs much less often during tickle play with mothers and adults, and in this context there may be less need for

matching because the infant is usually being tickled by their mother or other trusted adult. Facial joy during tickling may be an involuntary response to extreme stimulation (Provine, 2000) or an indicator of felt emotion (as suggested by early commentators on chimpanzee expressions: Darwin, 1872/1999; Ladygina-Kohts, 1935/2002).

Motor joy is more likely to be matched by play partners during social locomotor play and other non-contact types of social play rather than during contact play (in contrast to facial joy). Again, motor joy appears to be distinct in its contexts and functions from facial joy. During social locomotor play, infants were observed to slap the ground or platform or wave to encourage another to follow and partners would often respond with similar motor movements before following. Such gestural communication may be important in the chasing games which are in greater evidence in juvenile and adolescent chimpanzees (Tomasello, Call, Nagell, Olguin, & Carpenter, 1994).

Conclusions in relation to the matching of infant joy are limited to comparisons of matching across play contexts and across modalities (facial matching versus motor matching). The response of play partners when infants expressed joy via multiple modalities was not examined and neither was cross-modal matching of joy (for example, when infant facial joy was responded to with motor joy from the play partner). Furthermore, studies of facial mimicry often involve stricter criteria than were applied in this study, for example response latencies are used to distinguish rapid involuntary responses (< 1-second) from voluntary responses (Hatfield, Cacioppo, & Rapson, 1994), and certain scenes are excluded if physical contact or vocalisations are present as this could influence responses (Davila Ross, Menzler, & Zimmermann, 2008). More fine-grained

analysis of the video records are possible in future analyses but were outside the scope of the present study.

In summary, the differential rates of infants' facial and motor joy across a range of social and solitary play types and social play partners, as well as differential rates of matching of infant joy by play partners, suggests that the functions of these expressions also vary by modality and by context. Infant chimpanzees, by the age of one-year-old, appear to be using facial expressions of joy to both negotiate mild forms of play fighting with peers as well as communicating their enjoyment of activities such as tickling with mothers. They appear to be using motor expressions of joy to gain the attention of playmates, request tickling, encourage chasing games, and perhaps to communicate their emotional state to distant caregivers. Playful interaction with mothers, peers, juveniles, and adults is important to the socialisation of joyful expressions in chimpanzee infancy, and mothers appear to take a greater or lesser role in eliciting infant joy depending on the composition of the group and the availability of other playmates.

Chapter 6. Joyful expressions of one-year-old Cameroonian Nso infants

A. Introduction

In human infancy, cultural factors influence the emphasis that parents place on joyful emotions. Mothers in middle-class urban societies in Western cultures engage in lots of face-to-face play and object play with their infants, particularly in the period between 3- and 6-months. Mothers encourage and build upon their infants positive emotional expressions, partly by imitating their infants smiles and laughter (Malatesta & Haviland, 1982). This parenting style is thought to foster independence and self-awareness (Keller, 2003). In contrast, the expression of joyful emotions is discouraged in some traditional societies such as the Gusii of Kenya (LeVine et al., 1996) and the Nso of Cameroon (Keller, Kartner, Borke, Yovsi, & Kleis, 2005), at least in the infant's first six months. Mothers in these cultures are less responsive than middle-class urban mothers to infants' smiles and laughs and they avert their gaze to dampen infant excitement. Instead, mothers focus on close body contact with their infants and motor stimulation, and they are highly responsive to infants' physical needs. This parenting style is thought to foster social cohesion and obedience (Keller, 2003).

Studies of joyful emotions in infancy, like the ones described above, have typically focused on mother-infant interactions in the first six months. Less is known about the socialisation of joyful emotions around the end of the first year. By this age, infants are exploring their environment and actively engaging in a

variety of playful activities while remaining in close proximity to their mothers or other caregivers. Therefore, this is a particularly interesting age to observe the influence of mothers and other members of the social environment in directing infants' expression of joyful emotions.

Knowledge about one-year-olds joyful emotions in traditional cultures is very limited. However, some studies of infants' play and other social interactions are relevant to the general context of joyful expressions in traditional cultures. Infants in traditional societies spend a considerable amount of time with older siblings who act as both care-givers and playmates. Mothers rely on older siblings to perform these roles because they have heavy economic and household responsibilities. In the Ngeca of Kenya, for example, mothers' relationships with their toddlers (two- to three-year-olds) focused on nurturing and training and it was the next older siblings (typically four- to five-year-olds) who were the main play partners (Edwards & Whiting, 1993). The communication style of Gusii mothers, from Kenya, with their infants was observed by LeVine et al. (1996). In a teaching task with their infants (aged from 6 months to 2 years), Gusii mothers gave none of the positive encouragement and praise that was typical of a comparison group of American mothers, and instead they gave practical demonstrations and verbal commands. The Gusii mothers were reported to be relatively restrained in terms of emotional expressivity but this was not objectively measured. Traditional cultures may value object play somewhat differently to Western cultures, particularly as children are likely to play with household objects rather than the purpose-made toys that are prevalent in Western cultures. Amongst the !Kung of Botswana, infants' (4- to 23-months) manipulation of objects was largely ignored by others whereas object exchanges

were positively received and encouraged (Bakeman, Adamson, Konner, & Barr, 1990). Studies that specifically focus on the socialisation of joyful emotions in traditional cultures will help to understand the importance of these emotions in development.

The contexts of joyful emotions in Western cultures have been directly studied in a small number of studies with infants around one-year-old. For example, infant smiles and laughter have been observed to occur more often during mastery of standing and walking than during other well-practiced tasks (Mayes & Zigler, 1992), and more often in daycare settings that at home (Rubenstein & Howes, 1979). The nature of the stimulus that elicits laugher was studied experimentally by Sroufe and Wunsch (1972) and towards the end of the first year social and visual scenarios increased in importance over tactile and auditory stimulation. A naturalistic study of the positive emotional expressions of American infants, aged from 6- to 18-months, was conducted by Adamson and Bakeman (1985). Infants were observed playing at home with their mother, with a peer, and alone. Positive expressions occurred at a particularly high rate during joint object engagement with mothers. The mode of expression also changed with age so that facial and motor expressions declined, particularly after 12 months, and vocal expressions became dominant by 18 months. It seems likely that these patterns are influenced by the cultural style of parenting which emphasises object exploration and vocal communication. Studies in other non-western cultures are necessary to appreciate the influence of social and environmental factors on joyful emotional expressions in infants.

In this study, the playful contexts of joyful expressions were studied in one-year-old infants from the Nso cultural community in Northwest Cameroon. The

Nso are a traditional rural, agricultural community. The culture is based on collectivist values in contrast to the individualistic values of Western societies. The main socialisation goals are compliance, conformity, respect and shared responsibility (Keller, 2007; Nsamenang & Lamb, 1998). The aim of the study was to explore socialisation of joy in Cameroon Nso culture and to compare the findings to existing knowledge of joy in Western infants.

B. Method

B.1. Participants

Families from the Nso cultural community in north-western Cameroon volunteered to participate in a study of infant development, conducted by Hildrud Otto from the University of Osnabrueck. A subsample of the infants from Otto's study (n= 8) was selected for the present study in which the video-taped observations were re-examined for joyful expressions.[4] Infants were selected at random from the larger sample with the proviso that there were equal numbers of male and female infants (the selection was made by Otto). The mean age of the eight infants was 12 months 18 days (SD = 11 days, range 12 months 0 days to 13 months 1 day). The mean age was averaged across the three days of observations for each infant. Three infants were first-borns and five were later-borns. Four of the later-borns had one older sibling aged between 4 and 8 years old while the other later-born infant was the youngest of 7 siblings. Mothers mean age was 25

[4] The present study was limited to eight infants because of the time-intensive nature of coding play. Furthermore, it was more appropriate to the purposes of the study to code prolonged observations of a few infants than to code brief observations of many infants. This ensured that there were sufficient observations of each infant in each play context to calculate rates of joy for each infant and mean rates of joy across all the infants.

years (SD = 8 years) and they had 7 years of schooling on average (SD = 2 year). One mother was married, one was widowed, and the others were single and lived in the parental home. Mothers earned money through farming, trading, sewing and one was a student.

B.2. Procedure

Hildrud Otto from the University of Osnabrueck along with a local research assistant obtained consent and made the video observations. The original procedure involved naturalistic observations of infants' daily lives plus an experimental set-up to measure mother-infant attachment in which infants were approached by a stranger. The present study is only concerned with the naturalistic observations of infants' daily lives. The naturalistic observations consisted of 9 x 20 minute videos of each infant though for the present study 4 x 20 minute videos of each infant provided sufficient data. The four videos were selected so that there would be one morning observation, two afternoon observations, and one evening observation for each infant. The observations were arranged at times when mothers were caring for their infants. Infants were the focal subjects in the videos and were followed wherever they wandered even if that meant the mother was not in view.

B.3. Coding System

There were six levels to the coding scheme: play, play type, play partner, level of engagement of the play partner, infant joy, and matching infant joy. For

full details of the codes refer to Appendix A. Coding was conducted using INTERACT coding software (Mangold, 2006).

Play was coded in 30-second intervals to identify periods of playful behaviour for further analysis. Intervals where there was no playful behaviour or where the focal infant was not visible were not analysed further. The mean percentage of intervals with playful behaviours was 68% (SD = 13). The total number of minutes of playful behaviour available for further analysis was 432 (ranging from 43 to 74 minutes for each infant). Further analysis of playful behaviours was conducted in 5-second intervals.

All five-second intervals (n = 5184) were coded for *play type.* Intervals where play type was coded as not playful or not visible where not analysed further. The remaining intervals of social and solitary play (n = 3834) were analysed for *infant joy* (the presence or absence of facial, motor, and vocal expressions of joy). All social play intervals (n = 1762) were coded for *play partner* and *level of play partner engagement*. All intervals containing both social play and infant joy (n = 1106) were coded for *matching infant joy* (the presence or absence of play partner joy in the same modality as infant joy).

C. Results

The results are based on analysis of eight Cameroon infants during periods of playfulness. Overall, infant joy was recorded during 1626 intervals, with facial joy in 687 intervals, motor joy in 807 intervals, and vocal joy in 805 intervals. Infant joy is reported as mean intervals per minute (ipm) during play. The maximum possible rate is 12 intervals per minute because play was coded in 5-

second intervals. Each mean score is based on all eight infants. This approach factors out variation between infants in the amount of time spent in different play contexts. The mean rates of overall joy and infant facial joy was calculated after excluding intervals where the face was not visible (12% of playful intervals). The mean rates of infant motor joy and infant vocal joy were based on all playful intervals as visibility of the body and audibility of vocalisations was excellent. Some descriptive statistics of the observations are included and are reported as mean percentages of playful intervals to distinguish them from the rate calculations. An alpha level of 0.05 was used for all statistical tests.

C.1. Infant Joy during Play

Overall, infant joy occurred at a mean rate of 5.1 ipm during play (SD = 1.2). Facial joy occurred at a mean rate of 2.3 ipm (SD = 1.2) and motor joy occurred at a mean rate of 2.6 ipm (SD = 0.8). Motor joy was expressed through playful waving or jiggling of arms and legs (47% of all motor expressions), playful hitting (39%), bouncing or jumping (6%), clapping hands (6%) and full body movements such as dancing (3%). Vocal joy occurred at a mean rate of 2.4 ipm (SD = 1.2). Vocal joy was expressed through laugher (31% of all vocal expressions) and joyful non-laughter vocalisations (69%). Infant joy was more likely to be expressed via one modality in any 5-second interval than via multiple modalities, with multiple modalities accounting for 35.4% (SD = 11.0) of infant joy intervals on average.

C.2. Infant Joy during Social and Solitary Play

Social play accounted for 45% (SD = 12.4) of infant playful intervals on average with the remaining 55% of playful intervals being spent in solitary play. The mean rates of infant joy per minute of social play and per minute of solitary play are shown in Figure 6.1.

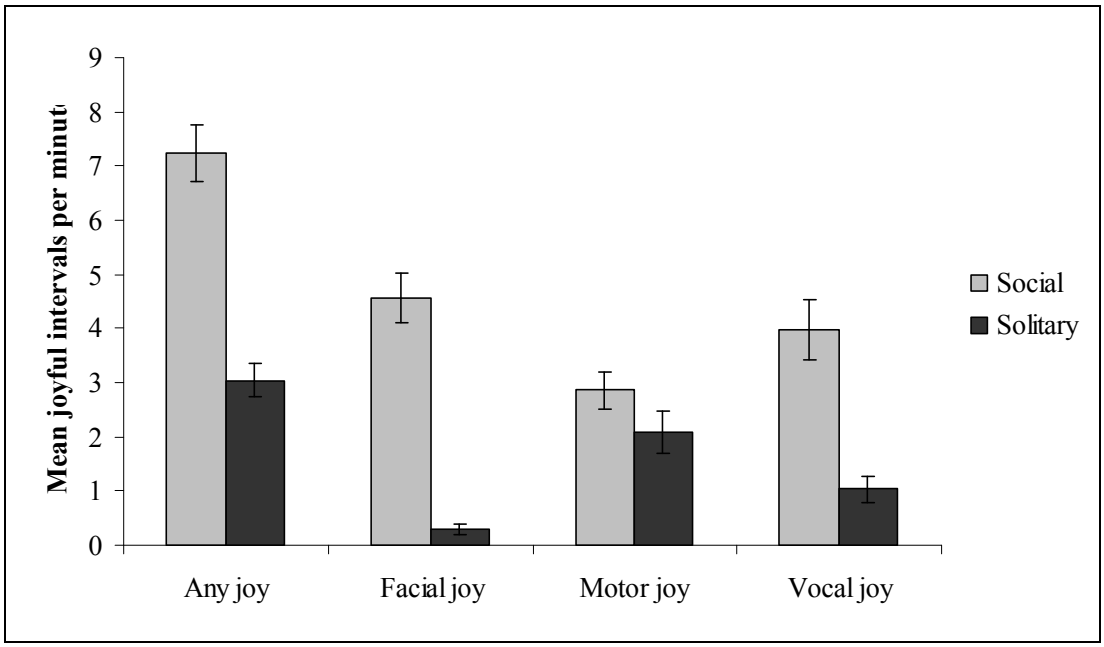


Figure 6.1: *Mean rate of Cameroon Nso infants' joyful expression in social and solitary play*

During social play, the mean rate of facial joy was similar to the mean rate of vocal joy while motor joy occurred at a slightly lower rate. During solitary play, the mean rate of motor joy was higher than the mean rate of vocal joy which in turn was higher than the mean rate of facial joy. A paired sample t-test found the mean rate of infant joy to be significantly higher during social play (M = 7.2, SD = 1.5) than during solitary play (M = 3.0, SD = 0.9), $t(7) = 5.87$, $p < .01$. Each

of the three modalities of infant joy – facial, motor, vocal – were compared across social and solitary play using paired sample t-tests. The mean rate of facial joy was higher during social play than during solitary play, $t(7) = 11.09$, $p < .01$, as was the mean rate of vocal joy, $t(7) = 6.60$, $p < .01$. The mean rate of facial joy was 15 times higher during social play than during solitary play, while the mean rate of vocal joy was four times higher. The mean rate of motor joy did not differ significantly across social and solitary play, $t(7) = 1.54$, $p = .17$.

C.3. Infant Joy by Play Type

A variety of social and solitary play types were observed in the Cameroonian Nso infants and the mean percentages of playful intervals observed in each type of play are given in Table 6.1. Solitary object play accounted for the highest proportion of play time at 44% with social object manipulation play accounting for the second highest proportion of play time at 19%. Social object exchange play accounted for was a relatively small proportion of observed playful intervals (3%) and therefore it was combined with social object manipulation play to create a social object play category. Social object exchange is a highly valued activity in some traditional African cultures (Bakeman, Adamson, Konner, & Barr, 1990) and by combining these observations with social object manipulation data it could continue to be part of the analyses. Social rhythmic play accounted for a small proportion of observed playful intervals (2%). However, as social singing and dancing are a highly valued activity in Nso culture, the social rhythmic observations were combined with social communication to permit further analysis. Both types of play share a focus on social relationships rather

than objects, locomotor goals, or physical contact. The combined category is called social comm-rhythmic play.

Table 6.1: *The different types of play engaged in Cameroonian Nso infants, as mean percentages of observed play time.*

		Play type						
		Social						
		Obj. manip.	Obj. exch.	Loco.	Rhythmic	Comm.	Contact[a]	Tickle / Other
% of playful intervals	**M**	**19**	**3**	**8**	**2**	**10**	**2**	**0**
	SD	7	4	4	3	5	3	0
		Solitary						
		Object	Loco.	Rhythmic	Other			
% of playful intervals	**M**	**44**	**10**	**0**	**2**			
	SD	10	4	0	1			

[a] The two types of social contact play, rough and tumble and mild contact, were combined into one category because of the low level of observations of these types of play.
Abbreviations are as follows: obj. manip. is object manipulation; obj. exch. is object exchange; loco. is locomotor; and comm. is communication.

Five play types had sufficient data to allow calculation of mean rates of joyful expression. These play types were social comm-rhythmic play, social

locomotor play, social object play, solitary locomotor play, and solitary object play. Each of the eight infants engaged in all five of these types of play. Rates were not calculated for the other play types because they each accounted for a very small proportion of observed play time and not all the infants were observed to engage in these types of play.

The mean rate of infant joy during five different types of social and solitary play is shown in Figure 6.2. One-way repeated measures ANOVAs were used to compare the rates of joy across the five different play types. There were significant differences in the mean rate of joy across play types for any infant joy, $F(4,28) = 43.09$, $p < .01$, $\eta^2 = .86$; for facial joy, $F(4,28) = 28.16$, $p < .01$, $\eta^2 = .80$; for motor joy, $F(4,28) = 15.27$, $p < .01$, $\eta^2 = .69$; and for vocal joy, $F(4,28) = 20.56$, $p < .01$, $\eta^2 = .75$.

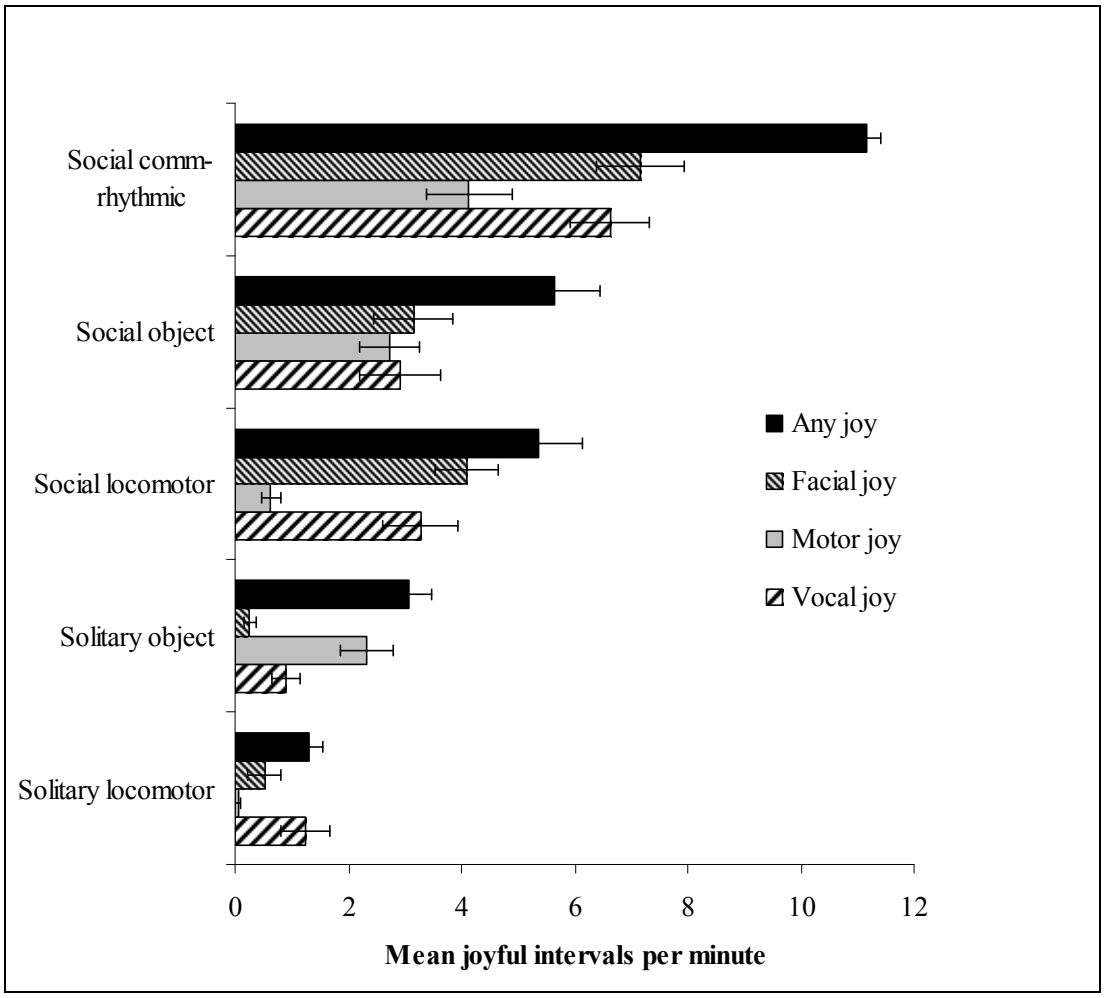


Figure 6.2: *Mean rates of Cameroon Nso infants' joyful expression by play type*.

Repeated planned contrasts were designed to make three comparisons: 1) the mean rate of joy during social comm.-rhythmic play versus social object play; 2) the mean rate of joy during social object versus solitary object play; and 3) the mean rate of joy during social locomotor play versus solitary locomotor play. A summary of the results is given in Table 6.2.

Table 6.2: Repeated planned contrasts on the mean rates of Cameroon Nso infants' joyful expression by play type.

		Any joy			Facial joy			Motor joy			Vocal joy		
Repeated planned contrasts	df	F	Sig.	η^2	F	Sig.	η^2	F	Sig.	η^2	F	Sig.	η^2
Soc. Comm-Rhythmic vs. Soc. Obj.	(1,7)	36.38	**	.84	11.45	*	.62	6.13	*	.47	12.90	**	.65
Soc. Obj. vs. Sol. Obj.	(1,7)	6.96	*	.50	20.26	**	.74	.42	ns	.06	9.34	*	.57
Soc. Loc. vs. Sol. Loc.	(1,7)	31.47	**	.82	33.68	**	.83	9.57	*	.58	13.59	**	.66

*p<.05. **p<.01

The play type with the highest mean rate of joyful intervals per minute of play was social comm-rhythmic. The rate of joy during social comm.-rhythmic play was significantly higher than the rate during the next highest play type, social object play, and this was the case for all three modalities of joy (facial, motor, and vocal). During social object play, there were significantly higher rates of overall infant joy, facial joy, and vocal joy, than during solitary object play. However, the rate of motor joy did not differ significantly between social object play and solitary object play. During social locomotor play, there were significantly higher rates of infant joy, across all three modalities, than during solitary locomotor play. Note that in all cases of significance, very large effect sizes were also found.

C.4. Infant Joy by Play Partner

The Cameroonian Nso infants engaged with a variety of play partners during social play. Play partners were visible during 81% of social play intervals, and the other 19% of intervals (where play partners were off-camera) were excluded from further calculations.

The highest proportion of infants' social play time was spent with their mothers (M = 55%, SD = 19). The remaining social play time was spent with young children, (M = 23%, SD = 27), older children (M = 4%, SD = 5), peers (M = 1%, SD = 3), other adults (M = 15%, SD = 8), or with animals, typically dogs (M = 2%, SD = 6). For further analyses, observations with young children, older children, and peers, are combined into one category called children, with the other categories being mother and adult. There was considerable variation between infants in the number of playful intervals observed with different play partners. However, all infants were observed to engage with mothers, children and adults and there was sufficient data on each infant to calculate the rate of joyful intervals per minute of play with each type of play partner (thus factoring out variations between infants in the amount of observed time with each type of play partner).

Mean rates of joyful intervals per minute of play with different play partners are shown in Figure 6.3. One-way repeated measures ANOVAs were used to compare the rates of joy across three different types of play partner: mother, child and adult. There were no significant differences across play partner in the mean rate of any infant joy, $F(2,14) = 0.03$, $p = .99$, $\eta^2 = .01$; of facial joy, $F(2,14) = 0.25$ $p = .78$, $\eta^2 = .04$; of motor joy, $F(2,14) = 0.23$, $p = .80$, $\eta^2 = .03$; and of vocal joy, $F(2,14) = .61$, $p = .56$, $\eta^2 = .08$. Note that very small effect sizes

accompany these non-significant p values. In other words, infants expressed joy at the same rate regardless of type of social partner.

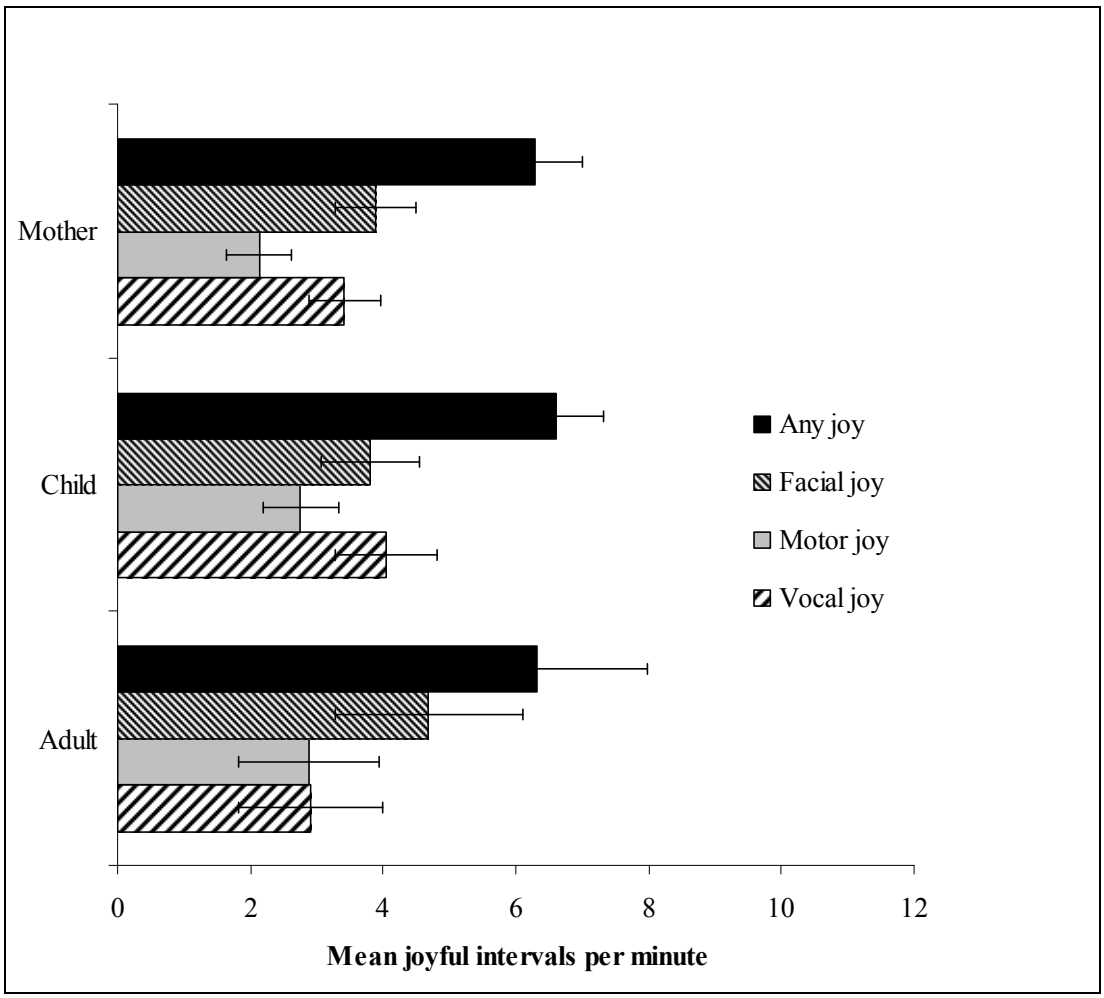


Figure 6.3: *Mean rate of Cameroon Nso infants' joyful expression by play partner*

C.5. Infant Joy by Level of Engagement of Play Partner

The level of engagement of infants' play partners varied such that 60% (SD = 18) of social play time was observed with play partners who were fully engaged with the infant, 17% (SD = 7) of social play time was observed with partly engaged play partners, and 19% (SD = 13%) of social play time was observed with play partners who were not engaged, meaning that they were not responding to infants attempts to initiate play.

Mean rates of joyful intervals per minute of play with play partners with different levels of engagement are given in Figure 6.4. One-way repeated measures ANOVAs were used to compare the rates of joy across three different types of play partner: mother, child and adult. There were no significant differences in the mean rate of infant joy by play partner engagement for any joy, $F(2,14) = 0.84$, $p = .45$, $\eta^2 = .11$; for facial joy, $F(2,14) = 1.10$ $p = .37$, $\eta^2 = .13$; for motor joy, $F(2,14) = 0.56$, $p = .59$, $\eta^2 = .07$; and for vocal joy, $F(2,14) = .30$, $p = .74$, $\eta^2 = .04$. Therefore, infants expressed joy at the same rate regardless of the level of engagement of their play partner.

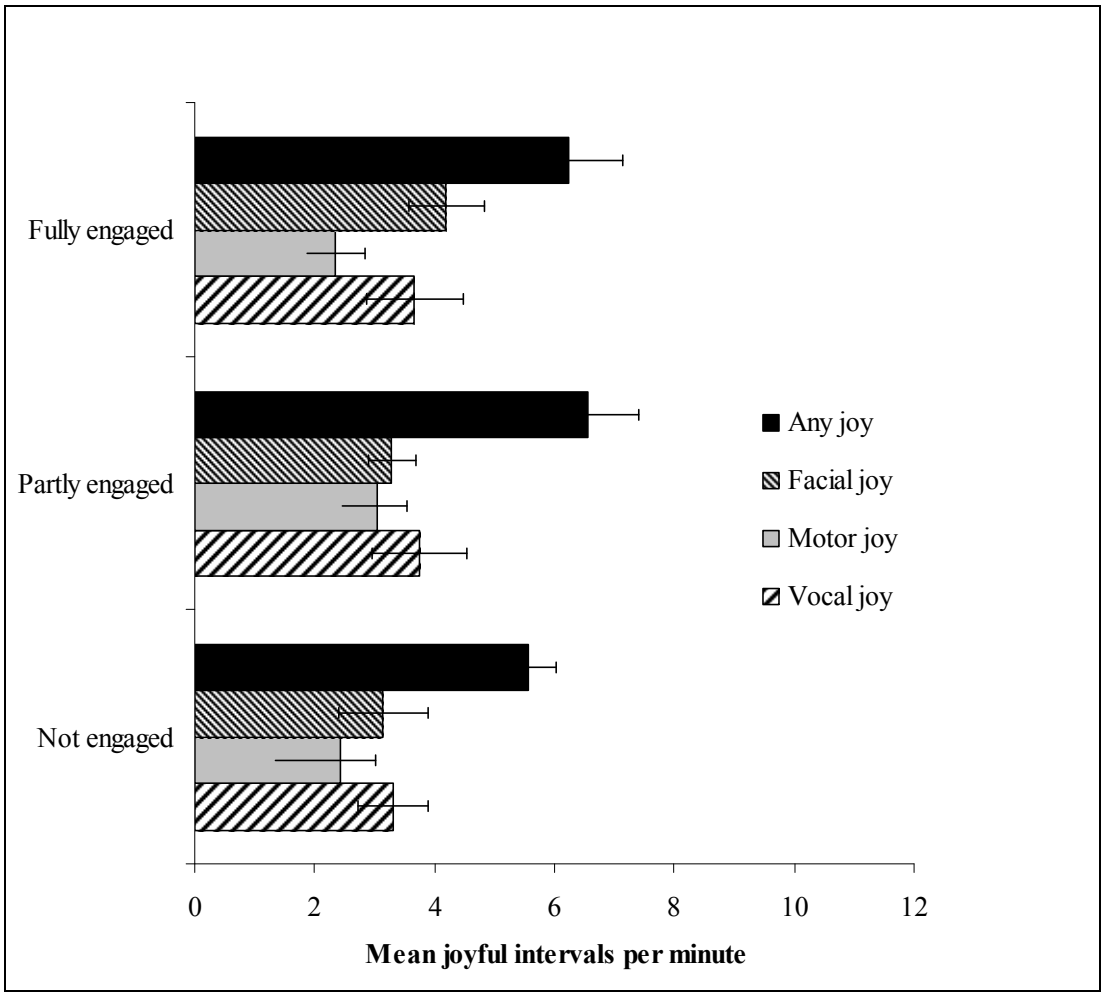


Figure 6.4: *Mean rate of Cameroon Nso infants' joyful expression by level of engagement of play partner*

C.6. Matching Infant Joy

There were 740 intervals of social play where infants expressed joy and where the expression of the play partner could be assessed. For facial joy, there were 272 intervals where the play partner's face was visible. For motor joy, there were 283 intervals where the play partner's body was visible. For vocal joy, there were 600 intervals in which the play partner's voice was audible. Intervals with no visibility or audibility of the play partner were excluded from all calculations. Matching of infant joy is reported as the mean percentage of infant joy intervals during social play that include an expression of joy by the play partner within the same interval. The mean score is the average of all eight infants. Expressions of joy have to be in the same modality to be classed as matching.

The mean percentage of infant joy that was matched by play partners was 49% (SD = 11). Play partners matched 56% (SD = 22) of facial joy, 25% (SD = 22) of motor joy, and 35% (SD = 18) of vocal joy. There was a high level of variation in the extent to which individual play partners matched infant joy, thus to determine if there was meaning in the Nso sharing of joy, the following analyses were conducted on all intervals of visible social play, rather than on mean scores.

There was a significant relation between matching joy and play partner, chi^2 (2) = 30.5, $p<0.001$ (see Table 6.3). Although mothers were the most frequent play partner, their matching of infant joy was equivalent to that expected by chance. Other children were the next most frequent play partner, but their matching of infant joy was also not different than expected by chance. However, adults other than the mother did differentially match infant joy expressions more often than expected by chance.

Table 6.3: *Partners matching of Cameroon Nso infants' joyful expressions as a function of type of play partner.*

	Partners' response to infant joy					
Play partner	Match joy			No match		
	O	E	$(O-E)^2/E$	O	E	$(O-E)^2/E$
Mother	210	220	0.4	190	180	0.6
Child	93	106	1.6	100	87	1.9
Adult	68	45	11.7	14	37	14.3

Note: O is Observed number of intervals, E is Expected value (computed by multiplying row and column totals and dividing by the grand total). The Chi^2 statistic is the sum of all the $(O-E)^2/E$ entries, thus the relative size of each entry indicates its relative contribution to the final statistical value. For 2 degrees of freedom, and probability less than 0.05, the critical Chi^2 value is 5.99, so $(O-E)^2/E$ entries above this value are considered significantly different from chance, with the direction of difference between observed and expected values determining the direction of the difference from chance.

A significant relation was found between matching joy and social play type, chi^2 (5) =126.5, $p<0.001$ (see Table 6.4). During social object manipulation play, there were fewer intervals with matched joy than were expected by chance. In two types of play, locomotor and contact/tickle, there was just the same amount of matching that would be expected by chance. However, in three types of social play, social communication, social rhythmic play, and social object exchange, there were more intervals of matched joy than was expected by chance. Overall, the social partners of Nso infants differentially matched infant joy expressions as a function of the type of social play displayed.

Table 6.4: *Partners matching of Cameroon Nso infant's joyful expressions as a function of play type.*

	Partners' response to infant joy					
Social Play type	Match joy			No match		
	O	E	$(O-E)^2/E$	O	E	$(O-E)^2/E$
Object manip.[a]	101	158	20.6	187	130	25.0
Object exch.[a]	51	37	5.3	16	30	6.5
Locomotor	38	41	0.2	37	34	0.3
Contact &tickle[b]	22	32	3.1	36	26	3.8
Communication	144	109	11.2	55	90	13.6
Rhythmic	51	29	16.7	2	24	20.2

Note: O is Observed value, E is Expected value (computed by multiplying row and column totals and dividing by the grand total). The Chi^2 statistic is the sum of all the $(O-E)^2/E$ entries, thus the relative size of each entry indicates its relative contribution to the final statistical value. For probabilities less than 0.05 and 5 degrees of freedom, the critical Chi^2 value is 11.07, so $(O-E)^2/E$ entries above this value are considered significantly different from chance. The difference between observed and expected values determines the direction of the difference from chance.

[a]Social object play was split into social object manipulation and social object exchange for this analysis.

[b]Social contact play and social tickle play were combined together for this analysis.

For facial expressions of joy, the number of intervals in which partners matched joy was not different than expected by chance (determined by a binomial for large samples, which approximates the z distribution: Siegel & Castellan, 1988). For both bodily and vocal expressions of joy, there was significantly less

matching than expected by chance (Table 6.5). This suggests that Nso play partners do not match the expressions of joy produced by one-year-old infants.

Table 6.5: *Partners matching of Cameroon Nso infants' joyful expressions as a function of modality of joy.*

	Partners' response to infant joy			
Joy modality	Match joy	No match	*Z*-score	sig
Face	144	128	0.97	ns
Body	97	186	5.29	***
Vocal	260	340	3.27	**
Any modality	407	333	2.72	**

Note: Entries are the number of 5-sec intervals. ** = $p<0.01$, *** = $p<0.001$, ns = not significant

D. Discussion

The study aimed to explore socialisation of joy amongst one-year-old infants from the Cameroon Nso cultural group. The infants utilised multiple modalities for joyful expressions, consisting of their face, voice, and body. Infants' expressed joy during a variety of solitary and social play types, and play partners matched some of the infants' expressions of joy during social play. However, there were significant variations in the rate of joyful expression, both overall and by modality, across different play contexts.

The different modalities of joyful expression – facial, motor, vocal – occurred at very similar rates across play as a whole and were present in all types of social

and solitary play. However, the social or solitary nature of play had a great influence on facial joy (12 times higher in social play) and vocal joy (4 times higher in social play), though not on motor joy (no significant difference). Furthermore, joy was more likely to be expressed through one modality (in a 5-second interval) rather than via multiple modalities, with multiple modalities of expression only accounting for about a third of all intervals of infant joy. Taken together, these findings suggest that the different modalities of joy hold different yet complimentary functions in the communication of emotion. Facial joy is a particular feature of social interactions, probably because individuals need to be close to each other for facial expressions to be visible. In contrast, motor joy, and vocal joy to a lesser extent, operate across social and solitary contexts and may help to communicate emotion to others who may or may not be directly interacting with the infant. Communication of infants' joyful emotions to their caregivers may have adaptive value by helping to strengthen bonds and promote playful behaviour (Fredrickson, 1998, 2003; Gervais & Wilson, 2005; Keltner & Gross, 1999), and this study suggests that communication of joyful emotions during solitary play activities may also help to facilitate infants' independent play and exploration by reassuring caregivers at a distance that infants are happily engaged in play. Experimental studies have shown that people, including infants, are sensitive to information from the body, voice and face when interpreting a person's emotional state suggesting that multiple modalities of joy help to disambiguate emotional communication (De Gelder & Bertelson, 2003; Rozin, Taylor, Ross, Bennett, & Hejmadi, 2005; Soken & Pick, 1992; Van den Stock, Righart, & de Gelder, 2007; Walker, 1982). This naturalistic study of Cameroonian Nso infants' joyful expressions adds a new perspective to such

studies by showing how the various modalities of joy are differentially expressed as a function of play context.

Examination of the contexts of Cameroonian Nso infants joyful expressions suggest that joy is being socialised to reflect values important to parents and the Nso culture. Object play accounted for two-thirds of Nso infants play time (44% is social and 22% is solitary) and joy was expressed at a much higher rate during social object play than solitary object play. Some of the typical contexts of Nso infants social object play included playing drums made from household items, object hiding and exchange, and playful interludes to household chores such as when mothers involve their infants in games related to food preparation. Joyfulness during social object play in the Nso infants seems to promote values related to sharing resources (object exchange), sharing responsibilities (household tasks), and social bonding (music-making). These findings support the apprentice model of infancy, which is particularly important in collectivist cultures, in which the infant participates in the everyday cultural and subsistence activities of the community (Keller, 2003). This pattern of object play has been found in infants from another traditional African society (though in this instance from a hunter and gatherer society from Botswana, the !Kung). Infant object exploration was largely ignored by !Kung caregivers but object exchange games were encouraged and supported complex traditions of object exchange in the !Kung (Bakeman, Adamson, Konner, & Barr, 1990). In contrast, Western infants engage in similar object activities to the Nso infants but play with purpose-made toys is much more prevalent in Western culture. American infants' joyful expressions have been found to occur at a higher rate during joint object exploration and successful object manipulation with supportive mothers than during other types of play with

mothers, peers and alone (Adamson & Bakeman, 1985). Initial observations of the one-year-olds in my British sample suggest that, like American infants, they also produce a high rate of joyful expressions during object manipulation play with mothers. For example, the British infants and their mothers were often observed to smile and laugh while pressing sound-effect buttons on toys and books. Object stimulation, of the type found in the play of Western infants and their mothers, is thought to be related to individualistic values and the promotion of cognitive development, exploration and discovery (Keller, 2002). Further analysis of object play amongst the British sample of one-year-olds will provide a direct comparison with the Cameroon Nso group and help to understand the similarities and differences in the expression of joy during object play across these two diverse cultures.

Although the Nso infants' rate of joy during social object play was relatively high, the highest rate of joy was observed during social communicative play, involving playful chatting and singing. The Nso infants and their families spent large amounts of the day outside (food preparation and other household tasks were often done in the area just outside the house) and therefore there were plenty of opportunities for spontaneous interactions with neighbours. Although social communicative play accounted for a relatively low proportion of Nso infant play time, it was a potent context for joyful expression. Observations in the evenings, after the daily work had been done, were not conducted in this research but may have offered greater opportunity to observe infant joy during social gatherings. In the British sample, observations were made in the typical home environment (in line with the Nso observations) and while mothers and infants were joyful as they chatted and sang to each other there was less opportunity to engage in these

activities with the wider family and social community, and such opportunities were dependent on the mother organising and attending social events (such as play dates with friends and toddler groups). The rate of Cameroon infants' joy during social communicative play cannot yet be compared with the British sample but it is clear that the contexts of social communicative play differ greatly between the two groups due to environmental factors (relating to the structures of families and communities). Nevertheless, it does appear that communicative play is an important context for joyfulness in both cultures. In the Nso culture, joy during social communicative play appears to be important to social bonding (R. Yovsi, personal communication, 2006). In British culture, the relevance of joyfulness during social communicative play is speculative but the promotion of language development and expressiveness is believed to be important to individualistic Western cultures (Keller, 2002).

Nso infants were equally joyful with all social partners (i.e., mothers, other adults and children) despite playing most often with their mothers (55% of play time was spent with mothers compared with 28% with children and 15% with adults). This reflects a shared responsibility for child development in Nso culture, as is the case in many traditional cultures (Edwards & Whiting, 1993; Hrdy, 2009; Keller, 2003). Social partners clearly enjoyed playing with infants and most of the time they devoted their full attention to the infants play (fully engaged for 60% of social play). Sometimes, play partners were distracted while playing with infants, often because they were engaged in household tasks or were talking to someone else, but this did not appear to unduly affect infants' rate of joyful expression.

Initial observations of the British sample suggest that infants spent a greater proportion of the observed time playing with their mothers than with older

siblings (where present), and the rate of joy appears to be higher with mothers than with older siblings (though this is yet to be analysed). All of the older siblings in the British sample were relatively young (2 – 4-years-old) whereas the Nso infants were observed with a greater variety of child play partners mostly aged between 2 and 10-years-old. Observations with British infants were conducted in the infants' typical home environment (as none of the infants attended organised day care) and so observations were mainly with the mother and the older sibling (where present). Studies of play between American infants, mothers, and their older pre-school age siblings also suggest that mothers are the preferred play partner for both infants and siblings though there was evidence that American siblings, like their mothers, support infant's object play (Lamb, 1978a, 1978b).

Social partners matched infants' joy expressions approximately half the time, and infant facial joy, rather than motor or vocal joy, was particularly likely to be matched by others. Matching occurred significantly more often than chance during social communication and social object exchange (i.e. activities which relate to culturally-important values). Joyfulness during such activities promotes social relationships and a sense of interconnectedness which are highly valued in collectivist cultures such as the Nso (Nsamenang & Lamb, 1998). Matching during social object manipulation play was less than expected by chance which again supports the idea that object manipulation skills are not valued as highly as other more socially relevant skills by traditional collectivist cultures such as the Nso (Keller, 2003). The only play partners to match infant joyful expressions more often than expected by chance were adults other than the mother. This may possibly be related to the importance placed on building positive social

relationships across the wider community. Responsiveness to infants emotional expressions and states has been the subject of considerable research attention and high levels of responsiveness to infants facial expressions is thought to relate to promote cognitive development (particularly in relation to understanding of the self) and values of individuality and uniqueness (Keller, 2002, 2007; Keller, Kartner, Borke, Yovsi, & Kleis, 2005). Studies of Cameroonian mothers with their younger infants (three-months-old) suggest that Cameroonian mothers are less responsive to infants smiles, less likely to engage in face to face interactions, and more likely to foster close body contact and motor stimulation than German mothers (Keller et al., 2005; Keller et al., 2004). However, by the time infants are one-year-old, Cameroonian mothers and others were observed to frequently share smiles and other joyful expressions with their infants, at differential levels across different playful activities. Further examination of the British video-tapes is necessary before drawing conclusions about how the rate of joyful expression matching compares across cultures.

This study demonstrates that the contexts of infants' joyful expressions seem to reflect broader social and cultural values. Furthermore, playful interaction with a wide range of children and adults helps to support the development of joyful emotions in infancy. However, comparative studies are essential to more fully understand the role of culture, social, and environmental factors. The focus on Cameroonian Nso infants and the spontaneous joyful expressions that arise during everyday activities has added a fresh perspective to the study of infant joy, which has largely focused on Western infants in settings manipulated by the experimenter. There is clearly opportunity to re-examine the existing video records to explore the nature of joy and the social context in even greater detail,

especially in relation to supportive and responsive actions of others. Further analysis of object play and social communicative play, in particular, will help to further understand how joy is being socialised to support cultural competence.

Chapter 7. Joyful expressions of one-year-old infants: Comparisons between humans and chimpanzees

A. Introduction

The emotion of joy, and its expression via smiling and laughter, is recognised by all human beings regardless of their culture and is evident from the first few weeks of life. Moreover, the expression of joy via play faces and play grunts appears to be recognized by many primate species (Palagi, 2007). Therefore, joy is generally regarded as one of the basic emotions, along with sadness, anger, fear, surprise, and disgust (Ekman, 1999c). Joyful emotions have a long evolutionary history but their adaptive value has been difficult to define. One theory is that experiencing joy and other positive emotions enables an individual to expand their thinking and so build a variety of personal resources that will help them to deal with future challenges (Fredrickson, 2003). Fredrickson calls this the 'broaden-and-build' theory. Although there are many theories about the more proximate functions of play (e.g. building social and motor skills: Barnett, 1998; Bateson, 2005; Bekoff, 1997; Fagen, 1982, 1984), Fredrickson's theory is designed to explain the ultimate function of play, which is under-studied in non-western humans and in non-human primates.

One way to further understand the value of joyful emotions, and the resources they help to build, is to look at their socialisation in infancy. Parents socialise emotions in their infants through their own expressions of emotion and their reactions to their infants emotions (Eisenberg, Cumberland, & Spinrad, 1998).

Furthermore, parents select activities and situations for their infants that generate certain emotions and they communicate their own ideals through their emotional reactions (Fredrickson, 1998). In many cultures and in many primate species, there is also considerable infant socialisation by peers and other subadult caregivers (referred to as alloparents in the comparative literature, Hrdy, 2009). A comparative perspective on emotional socialisation, considering cross-cultural and cross-species similarities and differences, will further our understanding of the flexibility of emotion expressions, and of the evolutionary foundations for the role played by socialisation in the process of emotional development (Bard, 2009; Bard et al., 2004; Fredrickson, 1998; Hrdy, 2009).

Comparisons between human and chimpanzee infants are relevant because of 1) their close evolutionary relationship; and 2) commonalities in the age of emergence of many emotional expressions including smiling and laughter (Bard, 1998), suggesting 3) that in the realm of emotional development there may be more similarities across hominoids than in other realms, such as motor development (Bard, in press). Comparisons are also relevant because there appears to be some similarities in early socialisation practices, especially those related to emotional engagements (Bard, 1994, 2009), and mutual gaze (Bard et al., 2005). Chimpanzee mothers, like human mothers, are sensitive to their infants' emotional development. Both wild and captive chimpanzee mothers elicit smiles ('play-faces') and laughter by tickling their infants (Bard, 1996; Goodall, 1986a), and immediately comfort infants when they emit facial or vocal distress (Bard, 2002; Goodall, 1986b). Chimpanzee mothers have occasionally been observed to encourage or exaggerate nonverbal expressions by the infants, for example by placing their finger in the mouth of very young infants to gently

extend the open mouth of play-face expression (Bard, 1996; Plooij, 1979), or by lifting the infants' chin to establish mutual gaze. These ostentatious behaviours, as well as the more subtle matching or sharing of emotional engagement, suggest that there may be a great deal of comparability in the processes by which chimpanzees and humans socialise emotion in their young infants (Bard, 2002; Gómez, 1996, Leavens & Todd, 2005). Common developmental processes in species separated by millions of years of evolution further suggests that these processes have a very long evolutionary history (Bard, 2009).

In human infancy, cultural factors influence the emphasis that parents place on joyful emotions. Mothers in middle-class urban societies in Western cultures engage in lots of face-to-face play and object play with their infants, particularly in the period between 3- and 6-months. Mothers encourage and build upon their infants positive emotional expressions, partly by imitating their infants smiles and laughter (Malatesta & Haviland, 1982). This parenting style is thought to foster independence and self-awareness (Keller, 2003). In contrast, the expression of joyful emotions is discouraged in some traditional societies such as the Gusii of Kenya (LeVine et al., 1996) and the Nso of Cameroon (Keller, Kartner, Borke, Yovsi, & Kleis, 2005), at least in the infant's first six months. Mothers in these cultures are less responsive than middle-class urban mothers to infants' smiles and laughs and they avert their gaze to dampen infant excitement. Instead, mothers focus on physical care, body contact, and motor stimulation. This parenting style is thought to foster social cohesion and obedience (Keller, 2003).

Studies of joyful emotions in infancy, like the ones described above, have typically focused on mother-infant interactions in the first six months. Less is known about the socialisation of joyful emotions around the end of the first year.

By this age both chimpanzee and human infants are exploring their environment and actively engaging in a variety of playful activities while remaining in close proximity to their mothers or other caregivers. Around this age, the attachment system is at its most active, moderating the balance between exploration and secure base behaviours. The attachment system appears to function similarly in chimpanzees and humans (van IJzendoorn et al., 2009), as least with regard to the regulation of negative emotion. How this balance of exploration and proximity may be affected by positive emotion, in both chimpanzees and in human, has been seriously under-investigated (Bard et al., 2004). Therefore, this is a particularly interesting age to observe the influence of mothers, and other social partners, in directing and sharing infants' expression of joyful emotions.

The present research takes a comparative approach to the study of joyful emotions in infants aged around one-year-old. This comparative approach will provide insight into the universal, culture-specific, or species-specific functions of joyful emotions in development. The research is unique in 1) making direct comparisons of the natural occurrence of joyful emotions and 2) in taking a comparative perspective across human cultures and primate species. Cameroonian Nso infants and chimpanzee infants will be studied as there is sufficient research on infancy in these groups to help place the results in context, and provide comparisons to existing literature on Western infants. A new perspective of infant development may well be provided by focusing on joyful emotions. The findings will contribute to theories of emotion socialisation and the evolutionary functions of joyful emotions.

In this chapter, I compare Cameroon Nso infants with chimpanzee infants on the rate of facial joy and motor joy across a range of play types and partners.

If the rates of facial joy and motor joy are similar then I can conclude there are similarities in outcome measures of joy across species. If similarities in joyful expression across contexts (social and non-social) are found, this will be stronger evidence in support of cross-species similarities. If differences in joyful expressions are found, it is not possible to conclude that the species differ without consideration of the comparability of socialisation practices across species. In addition to comparisons on the rate of infant joy, I compare Cameroon Nso infants with chimpanzee infants on the percentage of their facial and motor expressions of joy which are matched by play partners producing similar expressions. If similarities in sharing of positive emotion are found across species, then I can conclude there is evidence in support of a long evolutionary history of socialisation processes influencing positive emotion in hominoids (Davila Ross, Allcock, Thomas, & Bard, in press; Gervais & Wilson, 2005). If there are differences in relative amounts of sharing, then this would suggest differences exist between the groups in the socialisation of positive emotion.

B. Method

B.1. Participants

Two groups of one-year-old infants are compared in this study: human infants from the Cameroon Nso cultural community (see Chapter 6 for further details) and captive chimpanzee infants (see Chapter 4 for further details). It should be noted that only the 12-month-old observations are included in this chapter (data in Chapters 4 and 5 was based upon observations at 12- and 15-

months old as the greater volume of observations allowed for more detailed analyses).

B.2. Procedure

Naturalistic observations of infants' daily lives were videotaped for subsequent microanalysis (see Chapters 4 and 6 for further details). The present study is based only on 12-month-old infants and so for the chimpanzees there were approximately six hours of observation for each Chester Zoo infant (with three hours of each infant's observations randomly selected for analysis) and one to two hours of observations for each PRI infant.

B.3. Coding System

There were six levels to the coding scheme: play, play type, play partner, level of engagement of the play partner, infant joy, and matching infant joy. For full details of the codes refer to Appendix A. Coding was conducted using INTERACT coding software (Mangold, 2006).

Play was coded in 30-second intervals to identify periods of playful behaviour for further analysis. Intervals where there was no playful behaviour or where the focal infant was not visible were not analysed further. For the chimpanzee infants, the mean percentage of intervals with playful behaviours was 57% and the total number of minutes of playful behaviour available for further analysis was 537 (ranging from 40 to 108 minutes for each infant). For the Cameroonian infants, the mean percentage of intervals with playful behaviours

was 68% (SD = 13) and the total number of minutes of playful behaviour available for further analysis was 432 (ranging from 43 to 74 minutes for each infant). Further analysis of playful behaviours (for the other five levels of the coding scheme) was conducted in 5-second intervals.

C. Results

The joyful expressions of Cameroonian Nso infants and chimpanzee infants were compared with analyses of modality of expression, play type, play partner, play partners' levels of engagement, and matching of infant joy by play partners. The results are reported as mean joyful intervals per minute (ipm) of play, thus factoring out variations in the amount of time that each group or individual was observed engaging in different types of play. The mean score is the average of each group of infants. Rates could range from 0 to a maximum of 12 ipm, as the interval-based coding scheme had 12 x 5-second intervals per minute. An alpha level of 0.05 was used for all statistical tests.

C.1. Modality of Joyful Expression

The mean rate of facial joy was 2.3 ipm (SD = 1.2) for the Cameroonian Nso group and 2.1 ipm (SD = 1.1) for the chimpanzee group. (Note that playful intervals where the face of the focal infant was not visible were excluded from the calculation: Cameroonian Nso 12%, chimpanzees 32%,). An independent t-test was used to compare the rate of facial joy between the two groups and there was no significant difference, $t(13) = 0.24$, $p = .82$.

The mean rate of motor joy was 2.6 ipm (SD = 0.8) for the Cameroonian Nso group and 1.3 ipm (SD = 0.4) for the chimpanzee group. (Note that playful intervals where the body of the focal infant was not visible or obscured were excluded from the calculation: Cameroonian Nso 0%, chimpanzees 2%). An independent t-test was used to compare the rate of motor joy between the two groups and the rate was significantly higher for the Cameroon Nso group than for the chimpanzee group, $t(13) = 3.80$, $p < .01$.

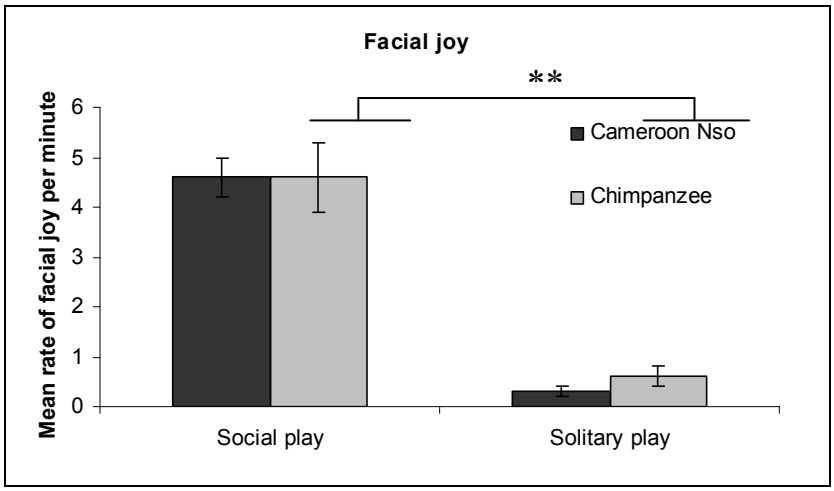
Joyfulness was more likely to be expressed via one modality in any 5-second interval than via multiple modalities, with multiple modalities only accounting for 35% (SD = 11) of intervals with joyful expressions on average.

C.2. Social versus Solitary Play

The Cameroon Nso group spent 45% of their observed play time engaged in social play whereas the chimpanzee group spent 37% of their observed play time engaged in social play. The remainder of play time was spent in solitary play for both groups. Figure 7.1 shows the mean rates of facial joy and motor joy during social and solitary play for the two groups.

Two mixed design 2 x 2 ANOVA were conducted to test the effects of the sociality of play (a within subjects factor) and group (a between subjects factor) on the rates of facial joy and motor joy. For facial joy, there was a significant effect of sociality with the mean rate of facial joy being significantly higher during social play than during solitary play, $F(1,13) = 145.70$, $p < .01$, $\eta^2 = .92$. There was no significant interaction between sociality of play and group, $F(1,13) = 0.11$, $p = .74$, $\eta^2 = .01$, and no effect of group, $F(1,13) = 0.13$, $p = .73$, $\eta^2 = .01$.

For motor joy, there was a significant effect of sociality with the mean rate of motor joy being significantly higher during social play than during solitary play, $F(1,13) = 8.05$, $p < .05$, $\eta^2 = .38$. There was also a significant effect of group with the mean rate of motor joy being significantly higher for the Cameroon group than for the chimpanzee group, $F(1,13) = 9.33$, $p < .01$, $\eta^2 = .42$. There was no significant interaction between sociality of play and group, $F(1,13) = 0.13$, $p = .73$, $\eta^2 = .01$. In summary, differences in the rate of joy during social and solitary play were similar for both the Cameroon Nso group and the chimpanzee group. The overall mean rate of facial joy was 10 times higher during social play than during solitary play while the overall mean rate of motor joy was 1.5 times higher social play than during solitary play. However, the Cameroon Nso group had a mean rate of motor joy that was 1.7 times higher than the chimpanzee group after factoring out the differences in the time spent in social and solitary play.



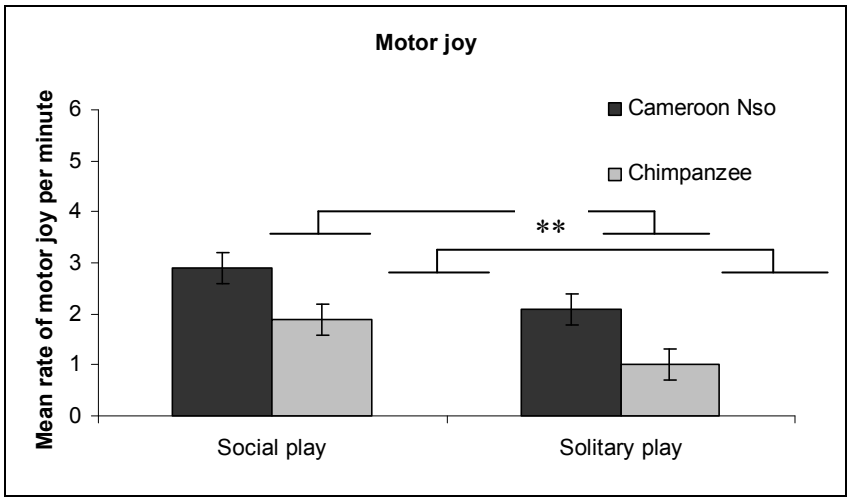


Figure 7.1. *Mean rates of joy during social and solitary play for Cameroonian Nso infants and chimpanzee infants: a) Facial joy and b) Motor joy.*

C.3. Play Type

The percentage of observed play time that the Cameroon Nso group and the chimpanzee group spent engaging in different types of social and solitary play

is shown in Table 7.1, and there is considerable variability between the two groups.

Table 7.1. *Distribution of play time across a range of play types for Cameroonian Nso infants and chimpanzee infants.*

		Mean % of playful intervals	
		Cameroon	Chimpanzee
Play type	Solitary object	44	15
	Solitary locomotor	10	48
	Social object	22	1
	Social contact	2	19
	Social locomotor	8	10
	Social communication / rhythmic	12	1
	Social tickle	0	6
	Solitary other	2	1
	Social other	0	0

For example, the Cameroon Nso group spent a high proportion of their play time engaging in solitary object play and social object play (44% and 22% of play time, respectively) while the chimpanzee group spent a high proportion of their

play time engaging in solitary locomotor play and social contact play (48% and 19% of play time, respectively).

Differences in the overall composition of play time between the two groups are factored out when looking at the mean joyful intervals per minute across the different play types. However, the mean rates of joy during social contact play cannot be compared between groups because the Cameroon group were rarely observed to engage in this type of play. Also, the mean rates of joy during social communication play and social object play cannot be compared between groups because chimpanzee infants were rarely observed to engage in these types of play. Three other types of play – social tickle, social other, and solitary other - were observed on too few occasions in both groups to permit analysis of mean rates of joy.

Comparison of the mean rates of joy for the Cameroon group and chimpanzee group across different play types is shown in Figure 7.2. Social communication play resulted in the Cameroon group's highest mean rates of facial joy (7.2 ipm) and motor joy (4.1 ipm), while social contact play resulted in the chimpanzee group's highest mean rates of facial joy (4.5 ipm) and motor joy (1.9 ipm).

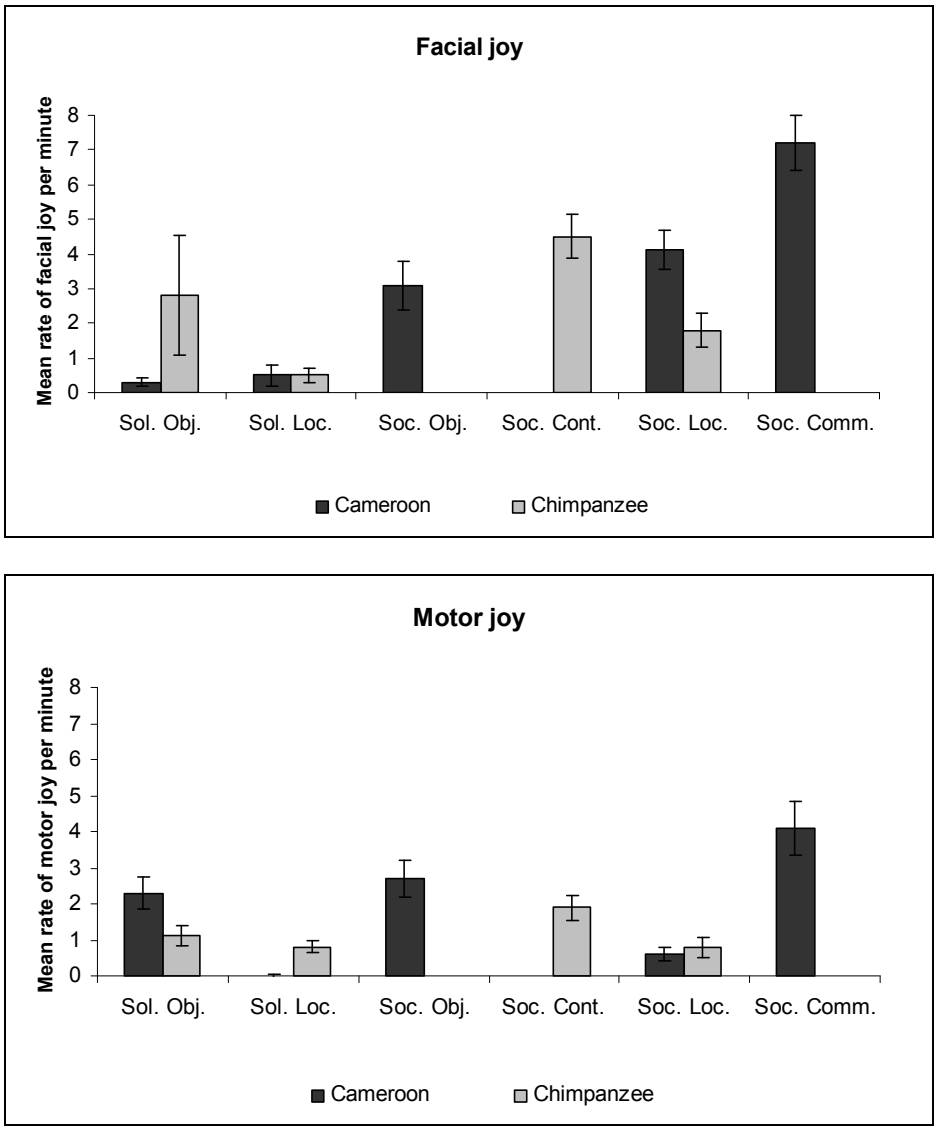


Figure 7.2. *Mean rate of joyful expression across different play types for Cameroonian Nso infants and chimpanzee infants.*

Note. Sol. Obj. is solitary object play, Sol. Loc. is solitary locomotor play, Soc. Obj. is social obect play, Soc. Cont. is social contact play, Soc. Loc. is social locomotor play, Soc. Comm. is social communication / rhythmic play. Where data is missing in the facial joy and motor joy charts, this is due to there being insufficient observations of that type of play for that group with which to calculate the mean rate of joy.

C.4. Play Partner

The Cameroon group and the chimpanzee group engaged with a variety of play partners during play and the mean percentage of time spent with different types of play partner is shown in Table 7.2. The mother accounted for the highest percentage of social play time for the Cameroon group (M = 55%) whereas peers accounted for the highest percentage of social play time for the chimpanzee group (M = 53%).

Table 7.2. *Distribution of social play time by play partner for Cameroonian Nso infants and chimpanzee infants*

		Mean % of social play intervals	
		Cameroon	Chimpanzee
Play partner	Mother	55	24
	Peer	1	53
	Young child	23	9
	Older child	4	0
	Adult	15	14
	Domestic animal	2	0

Note. Mean percentages were calculated after excluding social play intervals where the play partner was not visible (19% of intervals for the Cameroon group, 2% for the chimpanzee group).

The Cameroon group and chimpanzee group were compared on the mean rates of joy during play with mothers or other adults versus during play with peers or children (see Figure 7.3). One chimpanzee infant was excluded from the analysis of facial joy because of very few intervals of play with mothers or adults, none of which resulted in facial joy. This infant was in contrast to the other chimpanzee infants who had more intervals of play with mothers and adults with rates of facial joy ranging from 4.2 to 9.4 per minute.

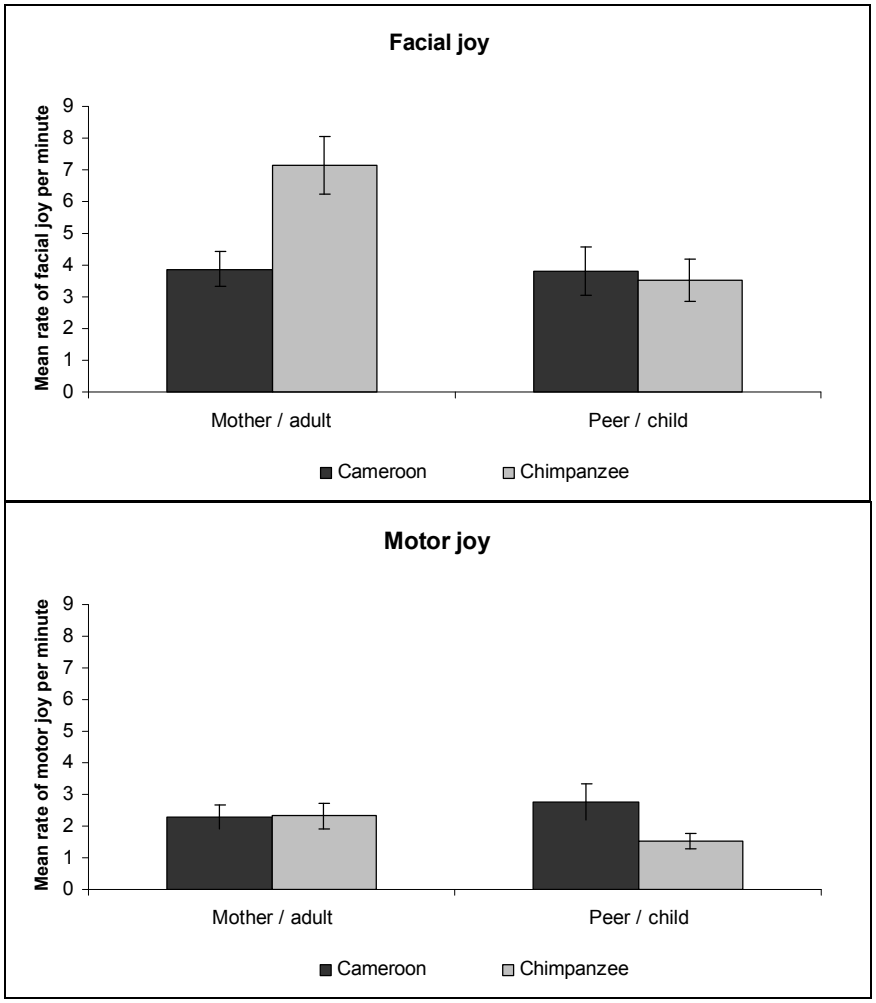


Figure 7.3. *Mean rate of joyful expression by play partner for Cameroonian Nso infants and chimpanzee infants: a) Facial joy and b) Motor joy.*

Two mixed design 2 x 2 ANOVA were conducted to test the effect of play partner (within subjects) and group (between subjects) on the mean rates of facial joy and motor joy. For facial joy (Figure 7.3a), there was a significant effect of play partner, $F(1,12) = 5.17$, $p < .05$, $\eta^2 = .30$, with the mean rate of facial joy being higher with mothers and other adults than with peers and other children. There was a significant effect of group, $F(1,12) = 5.46$, $p < .05$, $\eta^2 = .31$, with the mean rate of facial joy with partners being higher for the chimpanzee group than for the Cameroon group, after factoring out differences in the time spent with different types of play partners. There was also a significant interaction between play partner and group, $F(1,12) = 4.80$, $p < .05$, $\eta^2 = .29$, with the chimpanzee group having a higher mean rate of joy during play with mothers and adults than the Cameroon group but with no difference between the two groups in the mean rate of joy during play with peers and other children.

For motor joy (Figure7.3b), there was no significant effect of play partner, $F(1,13) = 0.12$, $p = .73$, $\eta^2 = .01$, no significant effect of group, $F(1,13) = 2.30$, $p = .15$, $\eta^2 = .15$, and no significant interaction, $F(1,13) = 1.83$, $p = .20$, $\eta^2 = .12$.

C.5. Level of Engagement of Play Partner

The mean percentage of social play time spent with play partners with different levels of engagement is shown in Table 7.3. Both the Cameroon group and the chimpanzee group spent similar percentages of time with play partners who were fully engaged, partly engaged and not engaged with the infant. The highest percentage of time in both groups was spent with play partners who were fully engaged with the infant (Cameroon: 60%, Chimpanzee: 63%). In the

subsequent analysis, partly engaged and not engaged are combined into one category 'not fully engaged'.

Table 7.3 *Distribution of social play time by play partners' level of engagement for Cameroonian Nso infants and chimpanzee infants.*

		Mean % of social play intervals	
		Cameroon	Chimpanzee
Level of engagement of play partner	Fully engaged	60	63
	Partly engaged	17	18
	Not engaged	19	19
	Other	4	0

Note. Social play intervals where the play partner was not visible have been excluded from calculations (19% of intervals for the Cameroon group, 2% for the chimpanzee group).

The Cameroon group and the chimpanzee group were compared on the mean rate of joy with play partners with different levels of engagement (see Figure 7.4). Two mixed design 2 x 2 ANOVA were conducted to test the effect of play partner engagement (within subjects) and group (between subjects) on the mean rates of facial joy and motor joy. For facial joy, there was a significant effect of play partner engagement, $F(1,13) = 6.90$, $p < .05$, $\eta^2 = .35$, with the mean rate of facial joy being higher with fully engaged partners than with partners who were not fully engaged with the infant. There was no significant effect of group, $F(1,13) = 1.03$, $p = .33$, $\eta^2 = .07$, and no significant interaction, $F(1,13) = 0.10$, $p =$

0.75, $\eta^2 = .01$. For motor joy, there was no significant effect of play partner engagement, $F(1,13) = 2.34$, $p = .15$, $\eta^2 = .15$, no significant effect of group, $F(1,13) = 1.09$, $p = .32$, $\eta^2 = .08$, and no significant interaction, $F(1,13) = 1.05$, $p = 0.32$, $\eta^2 = .08$. Vocal joy data was only collected for the Cameroon group. A paired sample t-test was conducted to compare the mean rate of vocal joy with fully engaged play partners to the mean rate of vocal joy with play partners who were not fully engaged for the Cameroon group and there was no significant difference, $t(7) = 0.15$, $p = .89$.

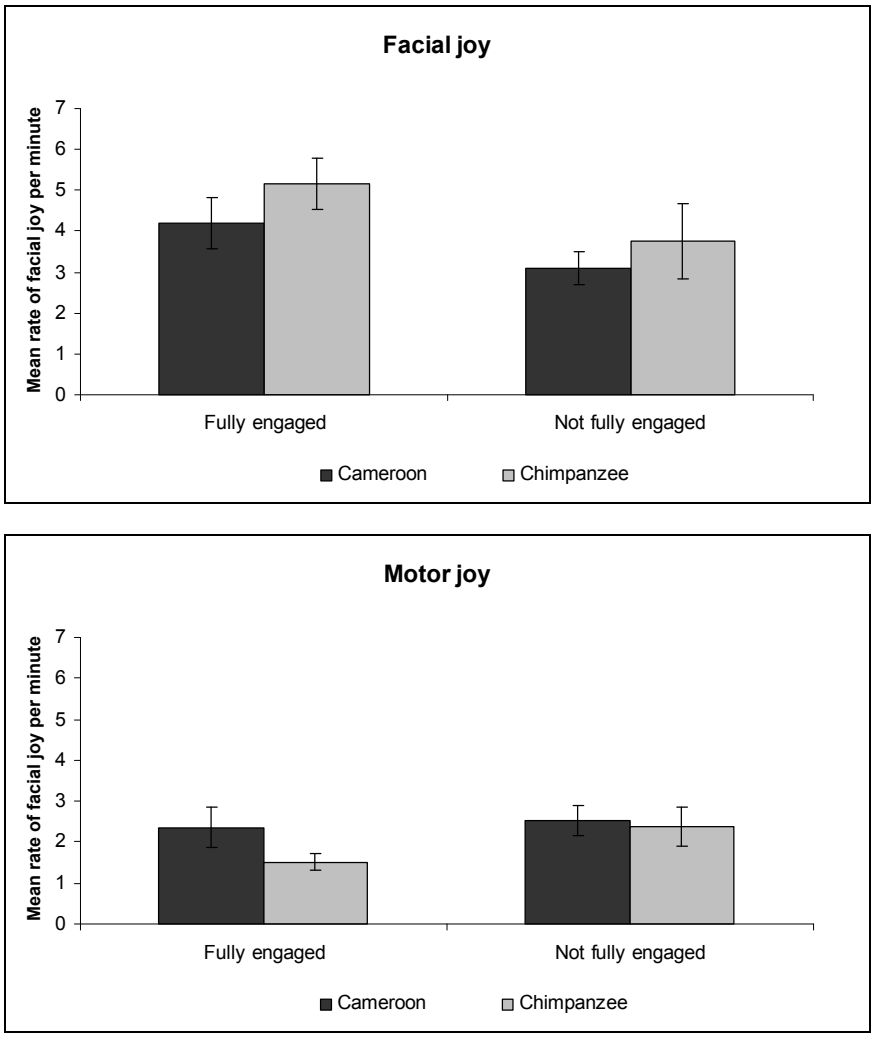


Figure 7.4. *Mean rate of joyful expression by play partners' level of engagement for Cameroonian Nso infants and chimpanzee infants: a) Facial joy and b) Motor joy.*

C.6. Matching Infant Joy

The joyful expressions of Cameroonian Nso infants and chimpanzee infants during social play were analysed to identify the percentage of these expressions

which were matched by play partners within the same 5-second interval. The analysis of facial joy matching is based on 272 intervals for the Cameroon group and 450 intervals for the chimpanzee group after excluding intervals where the facial response of the play partner was not visible. The analysis of motor joy matching is based on 283 intervals for the Cameroon group and 358 intervals for the chimpanzee group after excluding intervals where the motor response of the play partner was not visible.

The mean percentage of infants' joyful expressions which were matched by play partners is shown in Figure 7.5. A 2 x 2 mixed design ANOVA was conducted to test the effects of modality of joy (within subjects factor) and group (between subjects factor) on the percentage of infant joyful expressions that are matched by play partners during social play. There was a significant effect of modality with play partners matching a higher percentage of infant facial joy than infant motor joy, $F(1,13) = 6.21$, $p < .05$, $\eta^2 = .64$. The effect of group was marginally significant with Cameroon play partners matching a higher percentage of infant facial and motor joy than chimpanzee play partners, $F(1,13) = 4.40$, $p = .06$, $\eta^2 = .25$. There was no significant interaction between modality of joy and group, $F(1,13) = 0.75$, $p = .40$, $\eta^2 = .05$.

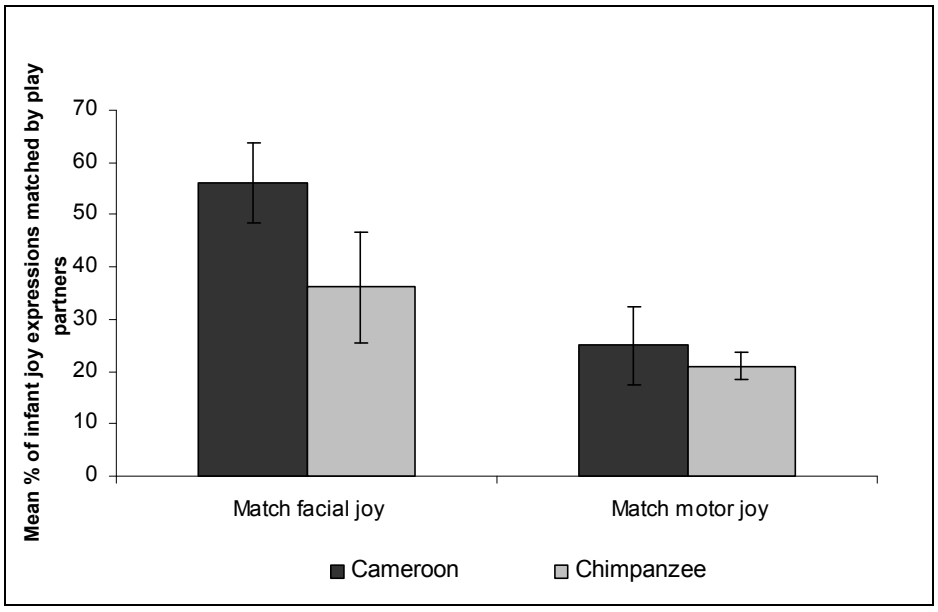


Figure 7.5. *Mean percentage of infant joyful expressions that are matched by play partners for Cameroonian Nso infants and chimpanzee infants.*

C.7. Matching Infant Joy by Social Play Type

Matching of infant joy by play partners during different social play types is reported as the percentage of total intervals in each group with infant joyful expressions (see Figure 7.6). Mean percentages were not calculated because there were insufficient observations of certain play types for some of the infants. The number of intervals of each play type in which play partners responses to infant joy were visible ranged from 67 to 262 intervals for the Cameroon group and 33 to 120 intervals for the chimpanzee group.

For the Cameroon group, the percentage of infant joy (both facial and motor) that was matched by play partners was considerably higher during social communication play than during social object play. During both types of play, matching was greater for infant facial joy than infant motor joy. For the

chimpanzee group, the percentage of infant facial joy that was matched by play partners was considerably higher during social contact play than during social tickle play, the latter play type having a very low incidence of infant facial joy matching. This pattern was reversed for the matching of infant motor joy by chimpanzee play partners and the percentage of matching was considerably higher during social tickle play than during social contact play.

C.8. Matching Infant Joy by Play Partner

Matching of infant joy by different types of play partners is reported as the percentage of total intervals in each group with infant joyful expressions (see Figure 7.7). Mean percentages were not calculated because there were insufficient observations with certain types of play partners for some of the infants. There were distinct differences between the two groups. In the Cameroon group, mothers and other adults matched a higher percentage of infant facial joy than did children. In contrast, in the chimpanzee group, the young chimpanzees (typically peers) matched a higher percentage of infant facial joy than did mothers and other adults who had a very low incidence of infant facial joy matching. Matching of infant motor joy had more similarity between the groups with mothers and other adults from both groups matching higher percentages of infant motor joy than did children and peers.

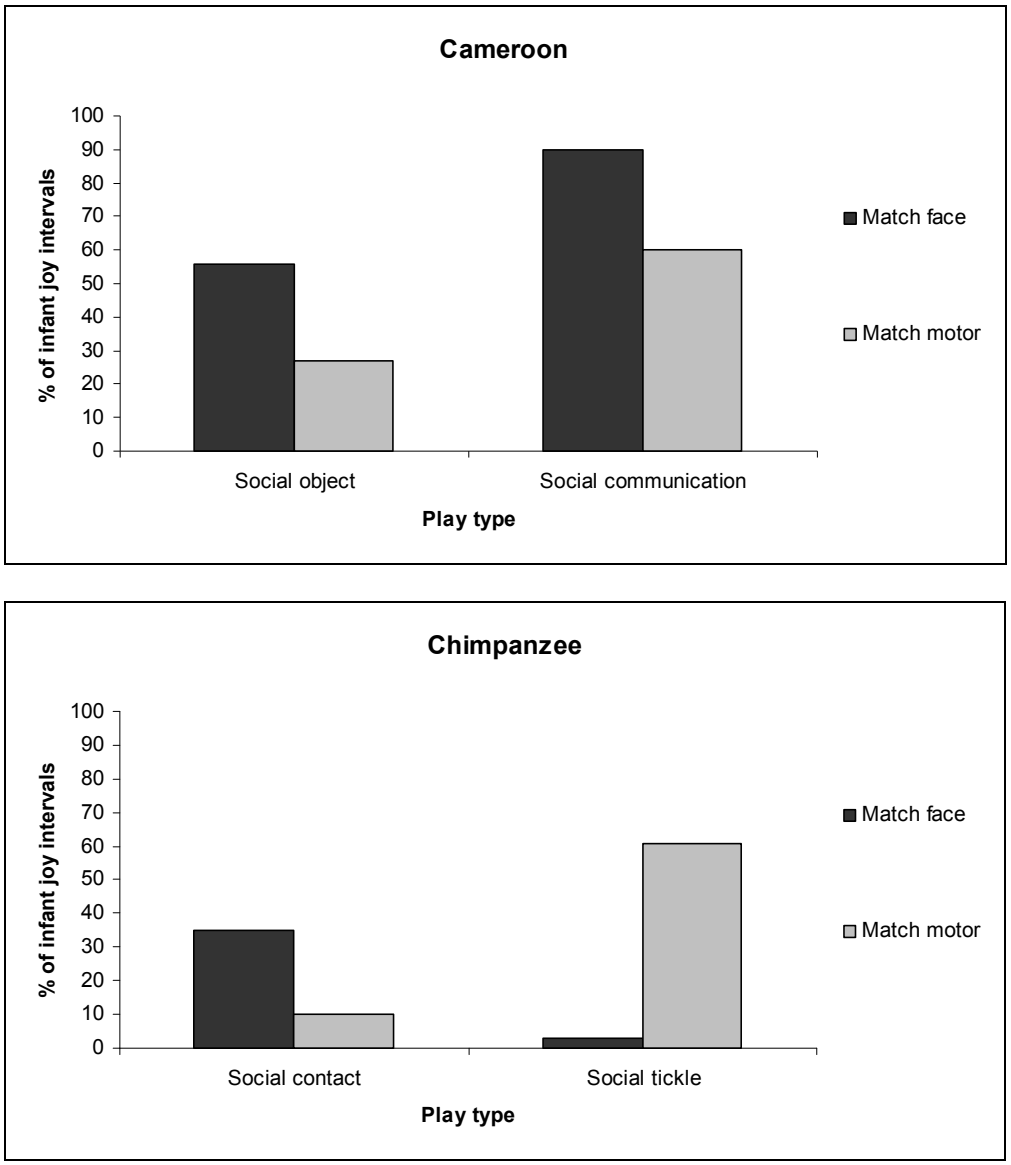


Figure 7.6. *Matching of infant joy by play partners during different types of social play for Cameroonian Nso infants and chimpanzee infants: a) Facial joy and b) Motor joy.*

Note. For the Cameroon group, there were insufficient observations of infant joy during social contact play, social locomotor play and social tickle play to report matching of infant joy. For the chimpanzee group, there were insufficient observations of infant joy during social locomotor, social communication play and social object play to report matching of infant joy.

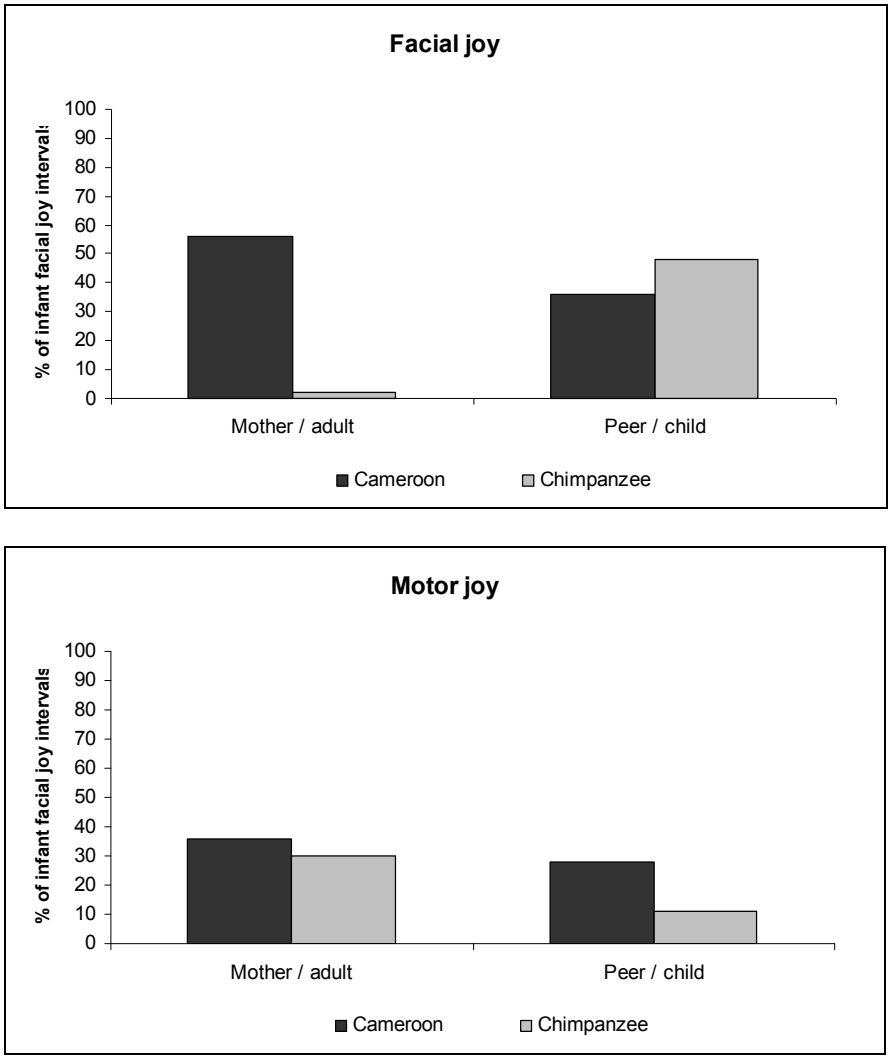


Figure 7.7. *Matching of infant joy by different play partners in Cameroonian Nso infants and chimpanzee infants: a) Facial joy and b) Motor joy.*

Discussion

Comparisons of naturalistic observations of one-year-old human infants from Cameroon's Nso community and one-year-old captive chimpanzee infants found that the rate of facial joy during play was the same in both groups despite

differences in the contexts of play. This finding highlights the close evolutionary relationship between humans and chimpanzees and suggests that the emotion of joy is important to infant development in both species. Motor expressions of joy occurred at a higher rate in the Cameroon Nso group than in the chimpanzee group. This is perhaps surprising given that motor development in one-year-old chimpanzees is more advanced than motor development in one-year-old humans. Motor joy was a particular feature of Cameroonian Nso infants object play, both social and solitary, (often hitting, waving or shaking objects) and social communication and rhythmic play (waving, bouncing, dancing), and these types of play accounted for smaller proportions of play time for chimpanzee infants.

Joy was expressed significantly more often in social than in solitary contexts for both groups though the contexts of joy varied greatly between species. Chimpanzee infants expressed joy at the highest rate during social tickle play and social contact play (mild play fighting) whereas Cameroon Nso infants expressed joy at the highest rate during social communication and rhythmic play and social object play.

Cameroonian Nso infants spent over half their social play time with their mothers, rather than other children or adults, while chimpanzee infants spent over half of their social play time with their peers. Both groups had similar rates of facial joy during peer play but chimpanzee infants had higher rates of facial joy in play with mothers and other adults than did Nso infants. Tickling was a highly effective way for chimpanzee mothers to elicit joy from their infants. Human infants also enjoy tickling but there were very few observations of tickling in the Cameroon Nso group. More observations of tickling may have been observed had observations taken place in the morning and evenings when infants were being

dressed and bathed. The rate of motor joy did not vary by play partner or by group. Both Nso and chimpanzee infants exhibited facial joy more often with partners who were fully engaged, as opposed to partners who were only partly or were not engaged. No differences were found in motor joy as a function of engagement level of partner.

Play partners from both groups matched a greater proportion of infant facial joy than infant motor joy. There was a trend for Cameroon Nso play partners, compared with chimpanzee play partners, to match a greater proportion of infant joy. However, there was significant variability in the proportions of infant joyful expressions that were matched within each group. Nso play partners matched a higher proportion of infant facial and motor joy during social communicative / rhythmic play than during social object play, whereas chimpanzee play partners matched a higher proportion of infant facial joy during social contact play than during social tickle play. Human communicative and rhythmic play and chimpanzee contact play are both potentially ambiguous, with fine lines between teasing and ridicule (humans) and playful or aggressive fighting (chimpanzees), and matching joyful expression may be important in resolving the ambiguity.

The final chapter (Chapter 8) will further discuss comparisons between human and chimpanzee infants as well as relating the findings back to the overall research aims of this thesis.

Chapter 8. Conclusions

In this final chapter, I discuss the key findings in relation to the original aims of the thesis. I conclude with a discussion of the strengths and weaknesses of the thesis and my personal learning.

A. Key Findings

In this thesis, I explored the contexts of joyful emotional expressions in infancy through naturalistic observation. Infants from two closely related primate species – humans and chimpanzees – were studied both in their own right and in direct comparison. The focus was on one-year-old infants whose developing social, motor, and cognitive skills present them with a greater choice of play activities and play partners than was possible earlier in life. Infants' everyday play activities were microanalysed using a coding scheme that was specifically designed to be applicable to both human and chimpanzee subjects. This coding scheme allowed examination of the contexts of joyful expression in terms of play types, play partners, and matching expressions by play partners. The aims of this thesis were to further understand the evolutionary heritage of joy, the socialisation of joy, the whole body expression of joy, and theories about the function of joy. The main findings are discussed below in relation to each of these aims.

A.1. The Evolutionary Heritage of Joy

The long evolutionary heritage of joy is supported in this thesis with the findings that chimpanzee and human infants express joy at equivalent rates during play. Infants from both species were observed to express joy during various types of social play (contact, tickle, communication, locomotor, object) and solitary play (locomotor, object) and during play with different partners (mothers, adults, children). Joy is clearly a fundamental emotion in the lives of humans and chimpanzee and, furthermore, the findings suggest that experiencing joy at a certain rate is important to infant development in both species. The matching of infant joy by play partners is also an important form of emotional communication and it occurred at equivalent rates in both the chimpanzee and human groups. The shared evolutionary origins of chimpanzee play faces and human smiles are well-documented. This research shows that these expressions are occurring at almost identical rates in chimpanzee and human infants during social play (high rate) and solitary play (lower rate) which may indicate that their functions remain very similar. Human smiling is thought to have a broader range of social functions (for example, affiliation, reconciliation, reassurance) than chimpanzee play faces though the similarities in the rate of expression across species, at least in infancy, suggest that the functions of chimpanzee play faces may be worth re-examining.

Fundamental similarities in the experience of infancy across chimpanzees and human groups may be behind the equivalent rates of joyful expression. Infants from both species receive care, affection, and play from mothers as well as from other members of their family and social group. Chimpanzee and human infants are born into complex social hierarchies and they need to learn how to cooperate and form alliances if they are to be successful members of the group.

Facial expressions of emotion may have evolved as a means of communication to support such social structures (Preuschoft & van Hooff, 1997). The findings in this thesis are expected to be transferable to wild chimpanzees and other human cultures. However, it is important to note that the infants studied in this thesis were living in stable environments without significant threats such as conflicts with other groups, loss of territory, or scarcity of food. Opportunities for infant play and joy may well be restricted in such situations.

Similarities between chimpanzee and human infants' joyful expressions are in most evidence when looking at play at a global level. Differences start to emerge when the specific playful contexts are considered indicating that joyful expressions are subject to different socialisation processes within each group. The key findings regarding the socialisation of joy are summarised in the next section.

A.2. The Socialisation of Joy

The rate of joyful expression, and the matching of these expressions by others, was examined during different types of play and with different play partners to expand existing knowledge about joyful expressions and their socialisation. The highest rates of infant joyful expression were found in play contexts which supported group cohesion and bonding, though these contexts were different for the chimpanzee and human groups. Chimpanzee infants expressed joy at the highest rate during tickling play which was generally with their mothers or other adults. The experience and expression of joy during tickling is likely to help infants to form close relationships and these relationships ultimately support the complex hierarchical structure and network of alliances

that exists in chimpanzee social groups. The Cameroonian Nso infants expressed joy at the highest rate during social communicative play which included playful chatting and singing with a wide variety of family and neighbours. These playful interactions reinforce the collectivist culture and the interdependent values of the Nso community.

The play contexts with the second highest rates of infant joy are also interesting because they also account for large proportions of play time. The play contexts with the highest rates of joy (above), actually accounted for relatively low proportions of play time. In part, this may be because they are typically adult led and adults are often busy with other daily activities. The play contexts with the second highest rates of joy are less reliant on adults and are often engaged in with peers and other youngsters. The chimpanzee infants expressed joy at the second highest rate during social contact play (a mild version of the rough and tumble play found in older chimpanzees) which was typically with peers or juveniles. Peers and juveniles matched infant joyful expressions at a higher rate than mothers and adults, and infants appeared to be learning together how to use joyful expressions to negotiate playful fighting. Such communication skills will be important as the infants grow older and engage in the more boisterous play fighting (and occasionally aggressive fighting) that is vital to maintaining the group hierarchy. The captive setting also affected the importance of social contact play as a context for joyful expression. Social contact play with peers and juveniles accounted for a higher proportion of play time and joyful expressions at Chester Zoo than at PRI, whereas, at PRI, social tickle play accounted for a higher proportion of play time and joyful expressions than at Chester Zoo. Group size may be a relevant factor as Chester Zoo has double the number of chimpanzee

than PRI with minor conflicts seemingly more common and so the development of play fighting skills may be of particular importance to the Chester Zoo infants.

The Cameroonian Nso infants expressed joy at the second highest rate during social object play and this reflects the value placed on object manipulation skills by the Cameroon Nso community, and humans in general. The social element of object play seems to be of great importance to the Cameroon Nso, perhaps because the Nso people use tools in cooperation with others both in the home and in farming. Solitary object play resulted in much lower rates of joy in Cameroonian Nso infants. In contrast, the chimpanzee infants spent considerable amounts of their play time engaging in solitary object play during which joy was expressed at a moderate rate but only a few instances of social object play were observed. Although the adult chimpanzees in both captive settings used sticks as tools to obtain food from man-made termite holes, and pass these skills down from generation to generation, there was less evidence of the cooperative tool use found in human societies. Nevertheless, chimpanzee infants clearly enjoy playing with objects despite object play being neither encouraged nor discouraged by mothers or other group members.

Mothers and children play different roles in the socialisation of joy across the Cameroonian Nso and chimpanzee groups. Chimpanzee mothers and other adults were responsible for the highest rate of infant joy observed in this thesis, and mainly elicited this joy during short but intense periods of tickling. However, the matching of joyful expressions mainly occurred with peers and juveniles rather than mothers. In contrast, in the Cameroon Nso group, mothers and adults played a greater role in matching infant joy, at least for facial joy, but all adults and children who played with the infant were equally good at eliciting infant joy.

In both groups, playful interactions with a wide range of play partners is important for socialising joy because the contexts of infant joy and the responses to infant joy vary by systematically by the type of play partner.

The influence of human cultures on the socialisation of joy was only touched upon in this thesis because the analysis of a direct comparison group of British infants has not been completed (though completion of this analysis is a priority for future work). Initial observations of the British sample, combined with published studies of Western infants, suggests that different social contexts for object play, communicative play, and rhythmic play are found between modern industrial cultures and traditional rural cultures and this is expected to influence the rate of infant joy and the matching of infant joy by others during these types of play. The importance of the mother versus other play partners in eliciting and matching infant joy is also expected to vary: the mother being particularly prominent in modern cultures and less so in traditional cultures where there is greater emphasis on shared community responsibility for child care.

A.3. The Whole Body Expression of Joy

This thesis attempted to provide a whole body perspective on the expression of joy by examining motor joy, and vocal joy for the humans group, alongside facial joy. The rate of motor joy was found to be equivalent to the rate of facial joy for both research groups and the rate of vocal joy was equivalent to the other modes of joy for the Cameroonian Nso infants. Therefore, motor and vocal expressions deserve greater attention by emotion researchers to complement the extensive research on facial joy.

Each modality of joy was distinctive in terms of its rate of expression across playful contexts. During solitary play, motor joy was expressed at a higher rate than facial joy, whereas during social play, facial joy was expressed at a higher rate than motor joy. This was the case for both research groups indicating that motor joy has evolved to complement facial joy and fulfil a different function in emotional communication more suited to situations where there is less face-to-face interaction. The large body movements involved in motor joy (e.g. waving, bouncing, spinning) make them more visible than facial expressions to others who are at some distance from the infants and may allow caregivers to know at a glance that the infant is happily playing (though further analysis of the responses of others to infant joy are needed to support this suggestion).

When motor joy was expressed during social play there were indications that it was fulfilling an attention-getting function for the chimpanzees. The chimpanzee infants' rate of motor joy increased when they were attempting to play with an individual who was either not yet engaging with them or who was somewhat distracted during play compared to when their play partner was already fully engaged. There was no evidence that Cameroonian Nso infants were using motor joy in this way perhaps because their developing vocal skills would soon provide them with effective means to request attention from others. Vocal joy, while occurring at a higher rate during social play than during solitary play, was not as skewed towards social play as facial joy indicating it could be an effective form of emotional communication where there is less face to face interaction.

The modality of infant joy also influenced the rate at which play partners matched these expressions. In the Cameroon group, facial joy was matched more than vocal joy which in turn was matched more than motor joy. In the chimpanzee

group, the situation was more complex. Facial joy was matched more during social contact play than during other social types of play whereas motor joy was matched less during social contact play and more during other social types of play (mainly locomotor play). It was unfortunate that it was not possible to record sound in either of the chimpanzee groups. This should be a goal for future research efforts. These findings highlights the importance of facial joy in close interactions, and suggest that motor joy may be more important when there is greater distance between play partners.

A.4. Theories about the Function of Joy

This thesis lends supports to the idea that there are multiple functions for the emotion of joy, though it was not designed to test specific hypotheses about these theories. In this section, the key findings will be outlined in relation to resource building theories, social-cultural theories, and social-communicative theories.

A resource-building function for joyful emotions is supported in this thesis. Joy in infancy is expressed at the highest rate during play contexts that support the development of social bonds (tickling in chimpanzees, communicative play in humans) and essential social skills (play fighting in chimpanzees, joint object manipulation in humans). Infants express joy at a lower rate during solitary locomotor play and solitary object play but joy did seem to occur at points of mastery or discovery. Thus, the findings support the theory that joyful emotions may be helping individuals to build personal resources such as social skills,

physical skills, and creativity that will aid future survival and success (Fredrickson, 2003; Fredrickson & Branigan, 2005).

Social-cultural theories propose that emotional experience is created by culture. This thesis provides evidence that the specific contexts of joyful expression are socialised to support group specific values and skills (as discussed in section A.2. above). Contexts of joyful expression were found to vary both between species and, to a lesser extent, between chimpanzees from two captive settings. Further studies are necessary to understand the degree of variation in the expression of joy across human cultures. However, the evolutionary heritage of joy is an important factor in its expression and there are strong similarities between chimpanzee and human infants' joyful expressions at a broader level.

Social communicative theories of emotions are particularly relevant to this research because of the focus on expressions. Some social communicative theories propose that expressions are not necessarily communicating emotional states but other messages about the sender's intentions, situation or likely actions (Fridlund, 1997; Russell, Bachorowski, & Fernandez-Dols, 2003) and this approach is often preferred when explaining the expressions of non-humans. Chimpanzee play faces are often regarded as signals which reassure others that play fighting behaviours are playful rather than aggressive (Flack, Jeannotte, & De Waal, 2004; Waller & Dunbar, 2005). However, this message is less relevant during other types of play, particularly tickling and solitary play, which result in chimpanzee infants joyful expressions. Joyful expressions can either be assumed to be capable of conveying a range of different messages depending on the context or a simpler explanation is that joyful expressions really are just

communicating an individual's emotional state, i.e. "I'm enjoying this", and the receiver decides how to use that information based on the context.

Additional analyses of the facial expressions observed in this thesis may reveal that there are different forms of facial joy with some of the most intense expressions (such as those during tickling) reflecting pure enjoyment and some of the less intense expressions being used as communicative signals to provide reassurance, affiliation, reconciliation etc. Such analyses will require more detailed examination of the contexts and the muscular movements involved in facial joy (see Thorsteinsson, Ross, and Bard ((2008) for an initial analysis). Social communicative theories also need to incorporate motor expressions and vocal expressions because this research has shown they are occurring both alone and in conjunction with facial expressions.

B. Strengths of this thesis

One of the major strengths of this thesis is its methodology, which involves both naturalistic observation and detailed contextual analysis of joyful expressions. This stands in contrast to many other studies of joyful expression which try to reproduce joyful expressions in situations that have been manipulated by the experimenter to some extent through selection of the setting, play partner and/or toys. The thesis was designed to explore similarities and differences in joyful expression across species, with the use of a rich coding system. It was not designed to test particular hypotheses but instead to provide a database that would also raise interesting avenues for further study. The observations collected as part of this thesis also provide a solid base with which one can explore additional

research questions. Additional questions can be answered by analysing the same video record using different coding schemes. The existing coding scheme can help to pinpoint particular play contexts and expressions of interest. For example, the muscular movements in facial joy can be subjected to FACS analysis (ChimpFACS, Vick et al., 2007; BabyFACS, Oster, 2005). Detailed facial movements can be identified, similarities and differences across species and across groups can be specified, and the relation between the form of expressions and play context can be determined (see Thorsteinsson, Ross, and Bard, 2008). Other potential studies of interest include investigating the consequences of infant joy, in both social and solitary play.

The coding scheme is a particular achievement of this thesis. The coding scheme was developed over the course of year. I developed it through an iterative process of observation, pilot coding, and refinement. Since there were many aspects to be coded, capturing infant behaviours, context, play partners and their behaviour, each scheme was developed and refined, and then the entire coding system was reviewed and refined. The end result is a coding scheme that can be applied to other human cultures and non-human primates to provide further comparisons with the existing research groups.

Another strength of this thesis is the comparison of non-typical research groups. Instead of looking at joy in Western subjects, the research provides a different perspective by considering joy in chimpanzee infants and Cameroon Nso infants. For both groups the findings can be considered against a considerable volume of research on infant development in these groups.

C. Weaknesses of this thesis

I collected observations of an additional human group, eight one-year-old infants living in Portsmouth. However, due to the limited time to finish the thesis and the initial foci on developing a single coding system, collecting and analysing the data from the chimpanzee group, and coding the Cameroon group, there was no time left to apply the coding system to the British group.

Thus, the chimpanzees were compared across two captive settings, revealing many similarities and also a difference in the prevalence of social contact play as a context for infant joy which may be related to group size and the prevalence of intra-group conflicts. Comparisons of the Cameroon Nso group to another human culture would have helped to explore not only the influence of human culture on joyful expression but also whether the similarities evident between the chimpanzees and Cameroon Nso could be generalised to similarities with other humans.

The lack of FACS analysis of the facial joy may be perceived as a weakness by some researchers. FACS researchers may be frustrated at not knowing the intensity of human smiles and whether they can be classified as Duchenne or non-Duchenne smiles. However, FACS analysis is so time consuming that it would have greatly restricted the amount of video that I could analyse and a detailed contextual analysis would not have been possible. In order to study context, I had to take a broad approach to joy and regard all facial joy as equal. This approach has resulted in a huge database of facial expressions, referenced by the context of play, and readily available for further analyses.

D. Personal learning

In this final section, I reflect on my personal learning from the early stages of developing the research questions, through the observations and analysis, dissemination of results, and potential future studies.

The development of the research questions took a considerable amount of time. From a starting point of wishing to study positive emotional expressions in infancy, I spent several weeks developing the specific aims. My ideas were modified and refined several times through discussion with my supervisor, and my supervisory team, reviews of the literature, and investigations of practical issues about gaining permission to observe infants and about getting access to pre-existing videos. The research objective and methodology also had to be submitted to the Department of Psychology for ethical approval. This process has made me appreciate the importance of allowing plenty of time for planning and discussion with colleagues before starting any research activity.

During the next phase, I began collecting videotaped observations, and began to appreciate the tension between taking advantage of good opportunities and the need to stick closely to a research plan. I found the initial observations with the chimpanzee group very interesting and I expanded the research aims to include a longitudinal element. While it was easy to make the video observations for these additional ages, I had not taken into account the time implications at the analysis stage. Coding an hour of videotape takes approximately 10 hours, and thus adding the longitudinal element was easy conceptually, but not easy practically. It entailed adding 15 hours of videotape, and thus 150 hours of analysis. This proved to be impractical, especially with the overarching aim to make comparable datasets for the human groups. In future, I would avoid the

temptation to add additional variables to the research that were not in the original aims, if there were similar time limitations to complete the project.

Observation, coding and quantitative analysis were conducted in parallel throughout the research period. I have learned that observational research is a delicate balance between capturing sufficient detail of the behaviours of interest while being simple enough to communicate clear messages. By observing and analysing in parallel I was able to manage this process on an ongoing basis but I have learned that I could have been even stricter about simplifying the coding and analysis. I coded at quite a detailed level in the first instance and then found that I had to combine some of the codes together where there were insufficient data for further analysis. In future studies, I might try to make the coding process more efficient by coding at a very simple level on the first instance, and then drilling down further where there are sufficient data.

Dissemination of the research findings is a challenge particularly when the research consists of detailed contextual analysis. The process of identifying the key messages was made easier by having the opportunity to practise communicating interim findings at various international and European conferences and receiving feedback. This was a valuable process and helped me refine the words that I used to describe play contexts, to improve the graphical presentation, and to identify the most interesting comparisons.

The next steps involve submitting my research studies for publication in collaboration with my supervisor and developing ideas for future research studies. There is opportunity for comparative studies with different human cultures and primate species using the same coding scheme and further analysis of the existing observations. I am particularly keen to finish comparative analyses that include

the British group of infants. On the basis of what I learned during this thesis, I think it is also important to collect additional observations of British infants outside the home, at toddler groups for example, where they have opportunity to interact with a wider range of people. I would also like to further analyse the expressions of joy that were found in solitary play. These occur at relatively low rates and so have rarely been studied in any detail. However, I am in the fortunate position to have many examples of joy during solitary play and it would be interesting to examine these expressions to determine whether they have social consequences, for example prompting others to engage with the infant. In conclusion, the process of completing this thesis has provided me with a solid foundation for a future as an independent researcher.

Appendix A. The Coding Scheme

Overview

1. Play Applies to: All video Interval duration: 30 seconds
Playful
Not playful
Not visible

2. Play type Applies to: Playful intervals from first coding category (Play) Interval duration: 5 seconds		
Social:	**Solitary:**	**None:**
Object exchange[1]	Object	Not playful
Object manipulation[1]	Locomotor	Not visible
Communication	Rhythmic	
Tickle	Other	
Mild contact[2]		
Rough and tumble[2]		
Locomotor		
Rhythmic		
Other		

[1] Social object exchange and social object manipulation can be combined into one code, social object, and this was often done for analysis purposes.
[2]Social mild contact and social rough and tumble can be combined into one code, social contact, and this was often done for analysis purposes.

3. Play partner Applies to: Social play intervals (as defined by Play Type coding scheme) Interval duration: 5 seconds
Mother Peer Young child / Juvenile Older child / Adolescent Adult Animal Not visible

4. Level of engagement of play partner Applies to: Social play intervals (as defined by Play type coding scheme) Interval duration: 5 seconds
Fully engaged Partly engaged Not engaged Other Not visible

5. Infant joy Applies to: Playful intervals (as defined by Play coding scheme) Interval duration: 5 seconds		
Facial joy	**Motor joy**	**Vocal joy (Humans only)**
Facial joy	Motor joy	Laugh
No facial joy	No motor joy	Other vocal joy
Not visible	Not visible	No vocal joy
		Not audible

6. Matching infant joy Applies to: Social play intervals (as defined by Play Type coding scheme) where the infant expresses joy (as defined by Joyful Expressions coding scheme) Interval duration: 5 seconds		
Facial	**Motor**	**Vocal (Humans only)**
Match face	Match motor	Match vocal
No match	No motor joy	No vocal joy
Not visible	Not visible	Not audible

Description of codes

1. Play

The following codes are mutually exclusive and exhaustive and are applied to the entire video collection in 30 second intervals.

Playful: The infant is playful at any point during the interval. When playful the infant will appear relaxed, alert, and positively engaged in an activity which does not meet any immediate physical needs such as sustenance or comfort. Some typical examples of playful behaviours are given below for humans and chimpanzees. These lists are not exhaustive and the context needs to be taken into account before deciding that these behaviours are playful:

Chimpanzees: Climbing, tumbling, swinging, chase games, gentle wrestling, hitting at playmates and objects, object manipulation, being tickled.

Humans: Crawling, walking, running, being tickled, object manipulation, repetitive language games, object games, singing, dancing to music.

Not playful: The infant is not playful at any point during the interval. The infant may be sleepy, distressed, observing others, or engaged in some activity that meets immediate physical needs. The following activities are typically not playful:

Chimpanzees: Chewing fruit, vegetables, straw, or branches; foraging for food; breast-feeding; being groomed; climbing to get back to mum.

Humans: Eating; everyday verbal and gestural communication e.g. when the infant wants a drink or to go somewhere; breast-feeding; watching the television; going to mother for comfort; spoken requests and responses to other.

Not visible: The infant cannot be seen or not enough of the infant is in view to be able to make a judgement about whether they are playful or not.

After coding play in 30 second intervals, all 'playful' intervals are split into smaller intervals of 5 seconds duration and analysed in further detail. 'Not playful' or 'obscured' 30 second intervals are not analysed any further for the purposes of this research.

2. Play type

Playful intervals identified by the 'Play' coding category are coded in 5 second intervals to identify types of play engaged in by the infant. The coding scheme is mutually exclusive and exhaustive. Where an infant is engaging in more than one type of play in an interval, code the type of play that is taking up the most time.

Social object exchange: The infant and another individual are engaged in playful exchange of on object (e.g. rolling balls to one and other) or playful competition for an object (e.g. tug of war games).

Social object manipulation: The infant and another individual are exploring or manipulating an object together or the infant is using an object to playfully hit or attract the attention of the other individual.

Social communication: The infant is engaging with another individual primarily through playful gestures or vocalisations. For example, human and chimpanzee

infants might wave at another individual to initiate play or human infants might be engaged in repetitive vocal games or teasing games with another.

Social tickle: The infant is being tickled or is tickling another individual. Tickling includes tickling with fingers or an object such as a feather, or nuzzling or blowing on another individual's body with the mouth.

Social mild contact: The infant is engaged in playful physical contact of a mild nature including gentle hitting, grabbing, and poking another individual. Mock biting may be a part of chimpanzees mild contact play.

Social rough and tumble: The infant is engaged in playful physical contact of a rougher more boisterous nature with another individual including wrestling, or rolling about, or being lifted, swung around, or turned upside down by an older individual. Mock biting may be a part of chimpanzees rough and tumble play though without any of the other features of rough and tumble play mock biting by itself would be classed as *social mild contact*.

Social locomotor: The infant is either following or chasing another individual, being followed or chased by another individual, or simply engaging in parallel actions with another individual such as walking and climbing together. Social locomotor play can also involve another individual supporting an infant's locomotor play, for example by pushing them on a swing or helping them to climb.

Social rhythmic: The infant and another individual are engaged in song, dance, or making music e.g. hitting a drum. The infant will have limited abilities in this area given their age but this code can be used when the infant is attempting to engage with the rhythmic activity.

Social other: The infant and another individual are engaged in another activity that has not already been described.

Solitary object: The infant is exploring or manipulating an object and no other individual is touching the object. The infant's visual attention is to the object alone and they are not sharing their attention between the object and any other individual who may be nearby. There is no indication that the infant wants another individual to become involved in playing with the object.

Solitary locomotor: The infant is crawling, walking, climbing, running, swinging, or performing a range of body movements such as rolling or tumbling. The infant is not engaged with any other individual during these activities. Chimpanzee infants sometimes use their mother's body as a climbing frame but this is coded as solitary as long as the mother is not actively assisting the infant.

Solitary rhythmic: The infant is singing, dancing, or making music e.g. beating a drum or playing with musical toys. They may be listening to music or watching the television but no other individual is encouraging them to perform these activities.

Solitary other: The infant is engaged in a solitary activity that has not already been described. This includes instances where the infant is playing with his or her own body, for example repeatedly grabbing at feet.

Not playful: The infant is not engaged in any playful activity.

Not visible: The infant cannot be seen or not enough of the infant can be seen to make a judgement about the type of activity they are engaged in.

3. Play partner

Where social play occurs (as defined by the coding category 'Play type') then these intervals are also coded to identify the main play partner. The play partner does not necessarily have to be actively engaged in the play but he or she is the focus of the infant's playful activities. The codes for the play partner are mutually exclusive and exhaustive.

Where there is more than one play partner during an interval, only code the play partner who appears to be the main focus of the infant's attention. Where the ages of the play partners are not known the coder has to estimate the age.

Mother: The infant's mother.

Peer: An individual aged within +/- 1 year of the focal infant.[5]

[5] In this research, there were no older infants in the chimpanzee groups whose age placed them outside the ranges for both the peer and juvenile codes. If this coding scheme was to be applied to other groups then a code for 'Older infant' may be necessary.

Young child (humans)/ juvenile (chimpanzee): The ages of the play partner for these codes differ depending on whether the subjects are humans or chimpanzees.
Young child (humans): A child aged between 2 and 10 years old.
Juvenile (chimpanzee): A chimpanzee aged between 2.5 and 6 years old and still displaying a white tuft of hair at the tailbone.

Older child (humans)/ Adolescent (chimpanzee): The ages of the play partner for these codes differ depending on whether the subjects are humans or chimpanzees.
Older child (humans): A child aged between 11 and 16 years old.
Adolescent (chimpanzee): A chimpanzee aged between 7 and 9 years old.

Adult: An individual who is aged 16 years or older in the human research groups or an individual who is aged 10 years or older in the chimpanzee research groups.

Animal: This code can apply to a family pet or to the dogs and chickens that wander around the Cameroon villages as long as the infant is trying to engage the animal in play. It does not apply to insects and worms that may be inspected by infants.

Not visible: The partner is out of sight or obscured from view and therefore cannot be identified. In some instances, the play partner will not be visible during the interval but it will still be possible from previous intervals to determine who the infant is playing with thus negating the need to apply this code.

4. Level of engagement of play partner

Where social play occurs (as defined by the coding category 'Play type') then these intervals are also coded to identify the level of engagement of the play partner with the infant's play. The codes for this category are mutually exclusive and exhaustive.

Fully engaged: The play partner is responding to the playful actions of the infant or actively encouraging the infant to play. The attention of the play partner is focused on the infant and the playful activity.

Partly engaged: The play partner is showing some attention to the infant. However, the play partner does not always respond to the infant or does so with less enthusiasm than the infant. The play partner appears distracted by other activities, other individuals, or seems to prefer to rest rather than engage in play.

Not engaged: The play partner shows no positive response to the infant's attempt to play. Instead, the intended play partner avoids, discourages, or ignores the infant.

Other: The play partner responds to the infant's attempts to play in a manner that is not negative (as with not engaged) but is not playful. This may include taking a protective role towards the infant.

Not visible: The play partner is either completely out of sight or their actions are obscured from view.

5. Infant joy

Playful intervals identified by the 'Play' coding scheme are coded in 5 second intervals to identify facial and motor expressions of joy in the focal infant. Vocal expressions of joy are also coded for the human research groups. The codes are mutually exclusive and exhaustive within each sub-category of facial, motor and vocal joy.

i). Facial joy

Facial joy: There are some differences in this expression between human and chimpanzee infants.

Human smile: The mouth is closed, partly open, or fully open with the corners retracted. An open mouth smile accompanying laughter is also coded as a smile.

Chimpanzee play face: The mouth is either partly or fully open; the lower jaw is relaxed and dropped; the corners of the mouth are typically not retracted. The upper or lower teeth may or may not be visible. The open-mouth expression accompanying chimpanzee laughter is also coded as a play face.

No facial joy: The infant's face is visible for at least part of the interval but he/she does not have a smile / play face or there is some uncertainty about the nature of the expression.

Not visible: The infant's face cannot be seen at all or there is never enough of the face visible to judge the expression.

ii) Motor joy

Motor joy: Motor expressions of joy are typically quick and exaggerated movements that are sometimes repetitive. They are judged to be joyful if they occur in a playful context. However, some similar movements can occur when infants are angry or frustrated. Examples of joyful motor expressions are given below:

- Waving arms or kicking legs.
- Hitting, slapping or stamping with feet in a way that makes contact with an object or another individual.
- Bouncing, jumping up and down, or basic attempts at dancing.
- Full body movements such as swings, acrobatic rolls and tumbles, leaps, and spins.

These movements should appear deliberate rather than occurring because of a fall or being pushed. These movements are more likely in chimpanzees given their more advanced motor development.

Tickle request gestures. To request tickling chimpanzee infants put their arms over their head and reach towards their shoulders.

No motor joy: The infant's body is in view but none of the joyful motor movements mentioned above are evident or there is some uncertainty about whether a motor movement is joyful.

Not visible: The infant's body cannot be seen at all or there is not enough of the body visible to judge motor expressions.

iii) Vocal joy (Human infants only)

Laugh: The infant laughs or squeals.

Other vocal joy: The infant produces playful speech or babbling.

No vocal joy: The infant does not produce any joyful vocal expressions or it is uncertain whether a vocal expression is joyful.

Not audible: A loud noise obscures vocalisations or it is difficult to tell who is making certain vocalisations probably because more than one individual is vocalising and faces are obscured.

6. Matching infant joy

Where social play occurs (as defined by the coding category 'Play type') and the infant expresses facial, motor or vocal joy (as defined by the coding category 'Joyful expressions') then these intervals are also coded to identify whether or not the play partner matches the infant's expression of joy during the same interval. The codes are mutually exclusive and exhaustive within each sub-category of matching facial joy, matching motor joy, and matching vocal joy.

i). Matching facial joy

This sub-category is only applied to social play intervals where the infant smiles or displays a play face.

Match face: The play partner smiles (humans) or displays a play face (chimpanzees) at any time during the interval.

No match: The play partner does not smile (humans) or display a play face (chimpanzee).

Not visible: The play partner's face cannot be seen at all or there is never enough of the face visible to judge the expression.

ii) Matching motor joy

This sub-category is only applied to social play intervals where the infant produces a joyful motor expression.

Match motor joy: The play partner produces a joyful motor expression at any time during the interval. This expression can either be the same as the infant's joyful expression (e.g. both wave their arms) or different (e.g. the infant waves his arms and the play partner bounces up and down). See the code for motor joy (3ii) for a list of joyful motor expressions. One addition to the list is tickling. Therefore, if the infant produces a tickle request gesture and the play partner responds by tickling the infant then this would be coded as matching motor joy.

No match: The play partner's body is visible but he/she does produce any joyful motor expression.

Not visible: The play partner's body cannot be seen at all or there is never enough of the body visible to judge the expression.

iii) Matching vocal joy (Humans only)

This sub-category is only applied to social play intervals where the infant produces a joyful vocal expression.

Match vocal joy: The play partner produces a joyful vocal expression at any time during the interval. This expression can either be the same as the infant (e.g. both laugh) or different (e.g. infant makes joyful babbling sounds and play partner laughs).

No match: The play partner does produce any joyful vocal expression though any vocalisations could be clearly heard if they did occur.

Not audible: The play partner's vocalisations cannot be heard. In some instances it may be difficult to tell who is making certain vocalisations probably because more than one individual is vocalising and faces are obscured.

Appendix B. Examples of infant smiles

Cameroonian Nso infants

Girl with her mother displaying wide open-mouthed smile. . .

. . . and displaying narrow smile with cheeks raised.

Boy displaying small open-mouthed smile with slightly raised cheeks

Boy displaying open-mouthed smile during an object exchange game

Chimpanzee infants

Carlos displaying open mouth play face with bottom teeth bared during tickle play with aunt

Carlos displaying open mouth play face with mouth corners raised during play with a juvenile

Carlos displaying small open-mouthed play face during solitary locomotor play

Frankie displaying open-mouth play face with top-teeth bared and mouth corners raised while being tickled by an unrelated adult

Rhiannon with mother while being tickled by Carlos and displaying open-mouth play face.

References

Adamson, L. B., & Bakeman, R. (1985). Affect and attention: Infants observed with mothers and peers. *Child Development, 56*, 582-593.

Aldis, O. (1975). *Play fighting*. New York: Academic Press.

Altmann, J. (1974). Observational study of behavior: Sampling methods. *Behaviour, 49*, 227-267.

Argyle, M. (2001). *The psychology of happiness* (2nd ed.). Hove, UK: Routledge.

Averill, J. R. (1980). A constructivist view on emotion. In R. Plutchik & H. Kellerman (Eds.), *Emotion: Theory, research, experience* (Vol. 1, pp. 305-339). New York: Academy Press.

Bainum, C. K., Lounsbury, K. R., & Pollio, H. R. (1984). The development of laughter and smiling in nursery school children. *Child Development, 55*, 1946-1957.

Bakeman, R., Adamson, L. B., Konner, M., & Barr, R. G. (1990). !Kung infancy: The social context of object exploration. *Child Development, 61*, 794-809.

Bard, K. A. (1994). Evolutionary roots of intuitive parenting: Maternal competence in chimpanzees. *Early Development and Parenting, 3*(1), 19-28.

Bard, K. A. (1996). *Responsive care: Behavioral interventions for nursery reared chimpanzees*. Tuscon, AZ: ChimpanZoo, Sponsored program of The Jane Goodall Institute.

Bard, K. A. (1998). Social-experiential contributions to imitation and emotion in chimpanzees. In S. Braten (Ed.), *Intersubjective communication and emotion in early ontogeny* (pp. 208-227). Cambridge, UK: Cambridge University Press.

Bard, K. A. (2002). Primate parenting. In M. H. Bornstein (Ed.), *Handbook of parenting, Volume 2: Biology and ecology of parenting* (Second ed., pp. 99-140). Mahwah: Lawrence Erlbaum Associates, Inc.

Bard, K. A. (2003). Development of emotional expressions in chimpanzees (Pan troglodytes). *Annals of the New York Academy of Sciences, 1000*(88-90).

Bard, K. A. (2005). Emotions in chimpanzee infants: The value of a comparative developmental approach to understand the evolutionary bases of emotion. In J. Nadel & D. Muir (Eds.), *Emotional development: Recent research advances* (pp. 31-60). Oxford, UK: Oxford University Press.

Bard, K. A. (2009). Social cognition: Evolutionary history of emotional engagements with infants. *Current Biology, 19*(20), R941-R943.

Bard, K. A. (in prep). Social-emotional communicative development in young chimpanzees: Ontogeny of social skills and social "manners".

Bard, K. A. (in press). Social-emotional communicative development in young chimpanzees: Ontogeny of social skills and social "manners".

Bard, K. A., Leavens, D., Custance, D., Vancatova, M., Keller, H., Benga, O., et al. (2004). Emotion cognition: Comparative perspectives on the social cognition of emotion. *Cognitie, Creier, Comportament*, 351-362.

Bard, K. A., & Leavens, D. A. (2009). Socioemotional factors in the development of joint attention in human and chimpanzee infants. In L. Roska-Hardy & E. M. Neumann-Held (Eds.), *Learning from animals?: Examining the nature of human uniqueness* (pp. 89-104). Hove, UK: Psychology Press.

Bard, K. A., Myowa-Yamakoshi, M., Tomonaga, M., Tanaka, M., Costall, A., & Matsuzawa, T. (2005). Group differences in the mutual gaze of chimpanzees *(Pan troglodytes)*. *Developmental Psychology, 41*(4), 616-624.

Bard, K. A., Todd, B. K., Bernier, C., Love, J., & Leavens, D. A. (2006). Self-awareness in human and chimpanzee infants: What is measured and what is meant by the mark and mirror test? *Infancy, 9*(2), 191-219.

Barnett, L. A. (1998). The adaptive powers of being playful. In M. C. Duncan, G. Chick & A. Aycock (Eds.), *Play and culture studies: Diversions and divergences in the field of play Vol.1* (pp. 97-119). Greenwich, CT: Ablex.

Bateson, P. (2005). The role of play in the evolution of great apes and humans. In A. D. Pellegrini & P. K. Smith (Eds.), *The nature of play: Great apes and humans* (pp. 13-24). London: The Guilford Press.

Bekoff, M. (1995). Play signals as punctuation: The structure of social play in canids. *Behaviour, 132*, 420-429.

Bekoff, M. (1997). Playing with play: What we can learn about cognition, negotiation, and evolution? In D. Cummins & C. Allen (Eds.), *The evolution of mind* (pp. 162-182). New York: Oxford University Press.

Bekoff, M. (2006). *Animal passions and beastly virtues: Reflections on redecorating nature*. Philadelphia, PA: Temple University Press.

Bekoff, M. (2007). *The emotional lives of animals*. Novato, CA: New World Library.

Bekoff, M., & Byers, J. A. (1981). A critical reanalysis of the ontogeny and phylogeny of mammalian social and locomotor play: An ethological hornet's nest. In K. Immelmann, G. W. Barlow, L. Petrinovich & M. Main (Eds.), *Behavioral development: The Bielefeld interdisciplinary project* (pp. 296-337). New York: Cambridge University Press.

Blurton Jones, N. (1976). Rough-and-tumble play among nursery school children. In J. S. Bruner, A. Jolly & K. Sylva (Eds.), *Play - Its role in development and evolution* (pp. 352-363). Harmondsworth, UK: Penguin.

Boesch, C., & Tomasello, M. (1998). Chimpanzee and human cultures. *Current Anthropology, 39*(5), 591-614.

Burghardt, G. M. (1984). On the origins of play. In P. K. Smith (Ed.), *Play in animals and humans* (pp. 5-41). Oxford, UK: Blackwell.

Burghardt, G. M. (2006). *The genesis of animal play: Testing the limits*. Cambridge, MA: MIT Press.

Burkhardt Jr, R. W. (2005). *Patterns of behavior: Konrad Lorenz, Niko Tinbergen and the founding of ethology*. Chicago: Chicago University Press.

Byers, J. A., & Walker, C. (1995). Refining the motor training hypothesis for the evolution of play. *The American Naturalist, 146*(1), 25-40.

Camras, L. A., Oster, H., Campos, J., Campos, R., Ujiie, T., Miyake, K., et al. (1998). Production of emotional facial expressions in European American, Japanese, and Chinese infants. *Developmental Psychology, 34*(4), 616-628.

Caron, J. E. (2002). From ethology to aesthetics: Evolution as a theoretical paradigm for research on laughter, humor, and other comic phenomena. *Humor, 15*(3), 245-281.

Cohen, L. J. (2001). *Playful parenting*. New York: Ballantine Books.

Cole, M., Cole, S. R., & Lightfoot, C. (2005). *The development of children* (5th ed.). New York: Worth.

Cosmides, L., & Tooby, J. (2000). Evolutionary psychology and the emotions. In M. Lewis & J. M. Haviland (Eds.), *Handbook of emotions* (2nd ed., pp. 91-115). New York: Guilford Press.

Darwin, C. (1872/1999). *The expression of the emotions in man and animals (3rd edition)* (Third ed.). London, UK: Fontana Press.

Davila Ross, M., Allcock, B., Thomas, C., & Bard, K. A. (in press). Aping expressions? Chimpanzees produce distinct laugh types when responding to laughter of others.

Davila Ross, M., Menzler, S., & Zimmermann, E. (2008). Rapid facial mimicry in orangutan play. *Biology Letters, 4*, 27-30.

Davila Ross, M., Owren, M. J., & Zimmermann, E. (2010). The evolution of laughter in great apes and humans. *Communicative and Integrative Biology, 3*(2), 191-194.

De Gelder, B., & Bertelson, P. (2003). Multisensory integration, perception and ecological validity. *Trends in Cognitive Science, 7*, 460-467.

De Waal, F. B. M. (2003). Darwin's legacy and the study of primate visual communication. In P. Ekman, J. J. Campos, R. J. Davidson & F. B. M. de Waal (Eds.), *Emotions inside out: 130 years after Darwin's The Expression of the Emotions in Man and Animals (Annals of the New York Academy of Sciences; vol. 1000)* (pp. 7-31). New York: The New York Academy of Sciences.

Diamond, J. (1993). The third chimpanzee. In P. Cavalieri & P. Singer (Eds.), *The great ape project* (pp. 88-101). New York: St Martin's Press.

Dickson, K. L., Walker, H., & Fogel, A. (1997). The relationship between smile type and play type during parent-infant play. *Developmental Psychology, 33*(6), 925-933.

Edwards, C. P., & Whiting, B. B. (1993). "Mother, older sibling and me": The overlapping roles of caregivers and companions in the social world of two- to three- year olds in Ngeca, Kenya. In K. MacDonald (Ed.) *Parent-child play*. Retrieved 7 August 2006, from http://site.ebrary.com/lib/portsmouth/Doc?id=10040225&ppg=150

Eibl-Eibesfeldt, I. (1973). The expressive behavior of the deaf-and-blind-born. In M. von Cranach & I. Vine (Eds.), *Social communication and movement* (pp. Check pgs). New York: Academic Press.

Eibl-Eibesfeldt, I. (2007). *Human ethology*. Piscataway, NJ: Aldine Transaction.

Eisenberg, N., Cumberland, A., & Spinrad, T. L. (1998). Parental socialisation of emotion. *Psychological Inquiry, 9*(4), 241-273.

Ekman, P. (1994). All emotions are basic. In P. Ekman & R. J. Davidson (Eds.), *The nature of emotion: Fundamental questions* (pp. 15-19). Oxford, UK: Oxford University Press.

Ekman, P. (1999a). Afterword: Universality of emotional expression? A personal history of the dispute. In *Charles Darwin's The expression of the emotions in man and animals* (Third ed.). London, UK: Fontana.

Ekman, P. (1999b). Basic emotions. In T. Dalgleish & M. Power (Eds.), *Handbook of cognition and emotion* (pp. 45-60). Chichester, UK: John Wiley and Sons.

Ekman, P. (1999c). Facial expressions. In T. Dalgleish & M. Power (Eds.), *Handbook of cognition and emotion* (pp. 301-320). New York: John Wiley & Sons Ltd.

Ekman, P. (2003). *Emotions revealed: Understanding faces and feelings*. London, UK: Phoenix.

Ekman, P., Friesen, W., & Ellsworth, P. (1982). Methodological decisions. In P. Ekman (Ed.), *Emotion in the human face* (2nd ed., pp. 22-38). Cambridge / New York: Cambridge University Press.

Ekman, P., & Friesen, W. V. (1971). Constants across culture in the face and emotion. *Journal of Personality and Social Psychology, 17*, 124-129.

Ekman, P., & Friesen, W. V. (1978). *Facial action coding system: A technique for the measurement of facial movement*. Palo Alto, CA: Consulting Psychologists Press.

Ekman, P., & Friesen, W. V. (1982). Felt, false, and miserable smiles. *Journal of Nonverbal Behavior, 6*(4), 238-252.

Ekman, P., Sorenson, E. R., & Friesen, W. V. (1969). Pan-cultural elements in facial displays of emotion. *Science, 164*, 86-88.

Elkind, D. (2007). *The power of play: Learning what comes naturally*. Philadelphia, PA: Da Capo.

Fagen, R. (1981). *Animal play behavior*. New York: Oxford University Press.

Fagen, R. (1982). Skill and flexibility in animal play behavior. *The Behavioral and Brain Sciences, 5*, 162.

Fagen, R. (1984). Play and behavioural flexibility. In P. K. Smith (Ed.), *Play in humans and animals* (pp. 159-173). Oxford, UK: Blackwell.

Flack, J. C., Jeannotte, L. A., & De Waal, F. B. M. (2004). Play signalling and the perception of social rules by juvenile chimpanzees. *Journal of Comparative Psychology, 118*(2), 149-159.

Fogel, A., Hsu, H.-C., Shapiro, A. F., Nelson-Goens, G. C., & Secrist, C. (2006). Effects of normal and perturbed social play on the duration and amplitude of different types of infant smiles. *Developmental Psychology, 42*(3), 459-473.

Fogel, A., Nelson-Goens, G. C., Hsu, H.-C., & Shapiro, A. F. (2000). Do different infant smiles reflect different positive emotions? *Social Development, 9*(4), 497-520.

Fox, N. A., & Davidson, R. J. (1988). Patterns of brain electical activity during the expression of discrete emotions in ten month old infants. *Developmental Psychology, 24*, 230-236.

Fraiberg, S. (1974). Blind infants and their mothers: An examination of the sign system. In M. Lewis & L. A. Rosenblum (Eds.), *The effect of the infant on its caregiver* (pp. Check pgs). Oxford, UK: Wiley-Interscience.

Fredrickson, B. L. (1998). Cultivated emotions: Parental socialisation of positive emotions and self-conscious emotions. *Psychological Inquiry, 9*(4), 279-281.

Fredrickson, B. L. (2003). The value of positive emotions. *American Scientist, 91*, 330-335.

Fredrickson, B. L., & Branigan, C. (2005). Positive emotions broaden the scope of attention and thought-action repertoires. *Cognition and Emotion, 19*(3), 313-332.

Fridlund, A. J. (1997). The new ethology of human facial expressions. In J. A. Russell & J.-M. Fernandez-Dols (Eds.), *The psychology of facial expression* (pp. 103-129). Cambridge: Cambridge University Press.

Gervais, M., & Wilson, D. S. (2005). The evolution and functions of laughter and humor: A synthetic approach. *The Quarterly Review of Biology, 80*(4), 395-430.

Gómez, J. C. (1996). Ostensive behavior in great apes: The role of eye contact. In A. E. Russon, K. A. Bard & S. T. Parker (Eds.), *Reaching into thought: The minds of the Great Apes* (pp. 131-151). Cambridge, UK: Cambridge University Press.

Goodall, J. (1965). Chimpanzees of the Gombe Stream reserve. In I. deVore (Ed.), *Primate behavior* (pp. 425-473). New York: Holt, Rinehart and Winston.

Goodall, J. (1986a). *The chimpanzees of Gombe: Patterns of behavior*. Cambridge, MA: The Belknap Press of Harvard University Press.

Goodall, J. (1986b). *The chimpanzees of Gombe: Patterns of behaviour*. Cambridge, MA: The Belknap Press of Harvard University Press.

Harre, R. (1986). *The social construction of emotion*. Oxford, UK: Blackwell.

Harre, R., & Parrott, G. (1996). *The emotions: Social, cultural and biological dimensions*. London: Sage.

Hatfield, E., Cacioppo, J. T., & Rapson, R. L. (1994). *Emotional contagion*. Cambridge, UK: Cambridge University Press.

Headland, T., Pike, K., & Harris, M. (Eds.). (1990). *Emics and Etics: The Insider/Outsider Debate*

Newbury Park, CA: Sage.

Hirata, S., Yamakosh, G., Fujita, S., Ohashi, G., & Matsuzawa, T. (2001). Capturing and toying with hyraxes (*Dendrohyrax dorsalis*) by wild chimpanzees (*Pan troglodytes*) at Bossou, Guinea. *American Journal of Primatology, 53*(2), 93-97.

Hofstede, G. (2001). *Culture's consequences: Comparing values, behaviors, institutions, and organizations across nations* (2nd ed.). Thousand Oaks, CA: Sage.

Hrdy, S. B. (2009). *Mothers and Others: The Evolutionary Origins of Mutual Understanding*. Cambridge, MA: Belknap Press.

Humphreys, A. P., & Smith, P. K. (1984). Rough-and-tumble in preschool and playground. In P. K. Smith (Ed.), *Play in animals an humans* (pp. 241-266). Oxford, UK: Blackwell.

Isen, A. M. (2004). Some perspectives on positive feelings and emotions: Positive affect facilitates thinking and problem solving. In A. S. R. Manstead, N.

Frijda & A. Fischer (Eds.), *Feelings and emotions: The Amsterdam symposium* (pp. 263-281). Cambridge, UK: Cambridge University Press.

Izard, C. E. (1997). Emotions and facial expressions: A perspective from differential emotions theory. In J. A. Russell & J.-M. Fernandez-Dols (Eds.), *The psychology of facial expression* (pp. 57-77). Cambridge: Cambridge University Press.

Izard, C. E., & Ackerman, B. P. (2000). Motivational, organizational, and regulatory functions of discrete emotions. In M. Lewis & J. M. Haviland (Eds.), *Handbook of emotions* (2nd ed., pp. 253-264). New York: Guilford Press.

Joffe, T. H. (1997). Social pressures have selected for an extened juvenile period in primates. *Journal of Human Evolution, 32*, 593-605.

Kagitcibasi, C. (1996). *Family and human development across cultures: A view from the other side*. Mahwah, NJ: Lawrence Erlbaum Associates.

Kalat, J. W., & Shiota, M. N. (2007). *Emotion*. Belmont, CA: Thomson Wadsworth.

Keller, H. (2002). Development as the interface between biology and culture: A conceptualization of early ontogenetic experiences. In H. Keller, Y. H. Poortinga & A. Scholmerich (Eds.), *Between culture and biology: Perspectives on ontogenetic development* (pp. 215-239). Cambridge, UK: Cambridge University Press.

Keller, H. (2003). Socialisation for competence: Cultural models of infancy. *Human Development, 46*, 288-311.

Keller, H. (2007). *Cultures of Infancy*. Mahwah, NJ: Lawrence Erlbaum.

Keller, H., Kartner, J., Borke, J., Yovsi, R., & Kleis, A. (2005). Parenting styles and the development of the categorical self: A longitudinal study on mirror self-recognition in Cameroonian Nso and German families. *International Journal of Behavioural Development, 29*(6), 496-504.

Keller, H., Voelker, S., & Yovsi, R. D. (2005). Conceptions of parenting in different cultural communities: The case of West African Nso and Northern German women. *Social Development, 14*(1), 158-180.

Keller, H., Yovsi, R., Borke, J., Kartner, J., Jensen, H., & Papaligoura, Z. (2004). Developmental consequences of early parenting experiences: Self-recognition and self-regulation in three cultural communities. *Child Development, 75*(6), 1745-1760.

Keltner, D., & Ekman, P. (2000). Facial expression of emotion. In M. Lewis & J. M. Haviland (Eds.), *Handbook of emotions* (2nd ed., pp. 236-249). New York: Guilford Press.

Keltner, D., & Gross, J. J. (1999). Functionalist accounts of emotions. *Cognition and Emotion, 13*, 467-480.

Keltner, D., & Haidt, J. (1999). Social function of emotions at four levels of analysis. *Cognition and Emotion, 13*, 505-521.

Kitayama, S., & Markus, H. R. (1995). Culture and the self: Implications for internationalizing psychology. In N. R. Goldberger & J. B. Veroff (Eds.), *The culture and psychology reader* (pp. 366-383). New York: New York University Press.

Kokkinaki, T. (2003). A longitudinal, naturalistic and cross-cultural study on emotions in early infant-parent imitative interactions. *British Journal of Developmental Psychology, 21*, 243-258.

Ladygina-Kohts, N. N. (1935/2002). *Infant chimpanzee and human child: A classic 1935 comparative study of ape emotions and intelligence* (B. Vekker, Trans.). Oxford, UK: Oxford University Press. (Original work published 1935).

Lamb, M. E. (1977). Father-infant and mother-infant interaction in the first year of life. *Child Development, 48*, 167-181.

Lamb, M. E. (1978a). The development of sibling relationships in infancy: A short-term longitudinal study. *Child Development, 49*, 1189-1196.

Lamb, M. E. (1978b). Interactions between eighteen-month-old and their preschool-aged siblings. *Child Development, 49*, 51-59.

Landau, R. (1977). Spontaneous and elicited smiles and vocalizations of infants in four Israeli environments. *Developmental Psychology, 13*(4), 389-400.

Lavelli, M., & Fogel, A. (2005). Developmental changes in the relationship between the infant's attention and emotion during early face-to-face

communication: The 2-month transition. *Developmental Psychology, 41*(1), 265-280.

Leavens, D. A., Hopkins, W. D., & Bard, K. A. (2008). The heterochronic origins of explicit reference In J. Zlatev, T. P. Racine, S. Sinha & E. Itkonen (Eds.), *The Shared Mind: Perspectives on Intersubjectivity* (pp. 185-214). Amsterdam: John Benjamins.

LeVine, R. A., Dixon, S., LeVine, S., Richman, A., Leiderman, P. H., Keefer, C. H., et al. (1996). *Child care and culture: Lessons from Africa*. Cambridge, UK: Cambridge University Press.

Lewis, K. P. (2005). Social play in the great apes. In A. D. Pellegrini & P. K. Smith (Eds.), *The nature of play: Great apes and humans* (pp. 27-53). London: The Guilford Press.

Lewis, M. (1982). Play as whimsy. *Behavioral and Brain Sciences, 5*, 166.

Liebal, K., Call, J., & Tomasello, M. (2004). Use of gesture sequences in chimpanzees

American Journal of Primatology, 64, 377-396.

Malatesta, C. Z., & Haviland, J. M. (1982). Learning display rules: The socialisation of emotion expression in infancy. *Child Development, 53*, 991-1003.

Mangold. (2006). INTERACT (Version 2.1 [Computer Software]). Arnstorf, Germany: Mangold International GmbH.

Markus, N., & Croft, D. B. (1995). Play behaviour and its effects on social development of common chimpanzees *(Pan troglodytes)*. *Primates, 36*(2), 213-225.

Martin, P., & Bateson, P. (2007). *Measuring behaviour: An introductory guide* (3rd ed.). New York: Cambridge University Press.

Martin, P., & Caro, T. (1985). On the function of play and its role in behavioral development. *Advances in the study of behavior, 15*, 59-103.

Masuda, T., Ellsworth, P. C., Mesquita, B., Leu, J., Tanida, S., & Veerdonk, E. (2008). Placing the face in context: Cultural differences in the perception of facial emotion. *Journal of Personality and Social Psychology, 94*(3), 365-381.

Matsuzawa, T., Tomonaga, M., & Tanaka, M. (Eds.). (2006). *Cognitive development in chimpanzees*. Tokyo: Springer-Verlag.

Mayes, L. C., & Zigler, E. (1992). An observational study of the affective concomitants of mastery in infants. *Journal of Child Psychology and Psychiatry, 33*(4), 659-667.

Mendoza-Granados, D., & Sommer, V. (1995). Play in chimpanzees of the Arnhem Zoo: Self-serving compromises. *Primates, 36*(1), 57-68.

Messinger, D. S. (2002). Positive and negative: Infant facial expressions and emotions. *Current Directions in Psychological Science, 11*(1), 1-6.

Messinger, D. S. (2005). Smiling. In N. J. Salkind (Ed.), *Encyclopedia of human development*. Thousand Oaks, CA: Sage.

Messinger, D. S., Fogel, A., & Dickson, K. L. (1999). What's in a smile? *Developmental Psychology, 35*(3), 701-708.

Messinger, D. S., Fogel, A., & Dickson, K. L. (2001). All smiles are positive, but some smiles are more positive than others. *Developmental Psychology, 37*(5), 642-653.

Niedenthal, P. M., Krauth-Gruber, S., & Ric, F. (2006). *Psychology of emotion*. New York: Psychology Press.

Nishida, T., & Inaba, A. (2009). Pirouettes: The rotational play of wild chimpanzees. *Primates, 50*, 333-341.

Nishida, T., & Wallauer, W. (2003). Leaf-pile pulling: An unusual play pattern in wild chimpanzees. *American Journal of Primatology, 60*(4), 167-173.

Noldus. (2006). Observer [Computer Software]. Wageningen, The Netherlands: Noldus Information Technology.

Nsamenang, A. B., & Lamb, M. E. (1998). Socialisation of Nso children in the Bamenda grassfields of Northwest Cameroon. In M. Woodhead, D. Faulkner & K. Littleton (Eds.), *Cultural worlds of early childhood* (pp. 250-259). London, UK: The Open University

Oatley, K., & Johnson-Laird, P. N. (1987). Towards a cognitive theory of emotions. *Cognition and Emotion, 1*, 29-50.

Online, O. (2006, June). play. v. Retrieved February 2, 2007, from http://dictionary.oed.com/cgi/entry/50181180

Oster, H. (2003). Emotion in the infant's face: Insights from the study of infants with facial anomalies. *Annals of the New York Academy of Sciences, 1000*, 197-204.

Oster, H. (2006). Baby FACS: Facial Action Coding System for Infants and Young Children. Unpublished monograph and coding manual.: New York University.

Oster, H., Hegley, D., & Nagel, L. (1992). Adult judgements and fine-grained analysis of infant facial expressions: Testing the validity of a priori coding formulas. *Developmental Psychology, 28*, 1115-1131.

Owren, M. J., & Bachorowski, J.-A. (2003). Reconsidering the evolution of nonlinguistic communication: The case of laughter. *Journal of Nonverbal Behaviour, 27*(3), 183-200.

Palagi, E. (2007). Play at work: Revisiting data focusing on chimpanzees (Pan troglodytes). *Journal of Anthropological Sciences, 85*(63-81).

Panksepp, J. (2000a). Emotions as natural kinds within the mammalian brain. In M. Lewis & J. M. Haviland (Eds.), *Handbook of emotions* (2nd ed., pp. 137-156). New York: Guilford Press.

Panksepp, J. (2000b). The riddle of laughter: Neural and psychoevolutionary underpinnings of joy. *Current Directions in Psychological Science, 9*(6), 183-186.

Panksepp, J. (2004). Basic affects and the instinctual emotional systems of the brain: The primordial sources of sadness, joy, and seeking. In A. S. R.

Manstead, N. Frijda & A. Fischer (Eds.), *Feelings and emotions: The Amsterdam symposium* (pp. 174-193). Cambridge, UK: Cambridge University Press.

Panksepp, J., & Smith-Pasqualini, M. (2005). The search for the fundamental brain/mind sources of affective experience. In J. Nadel & D. Muir (Eds.), *Emotional development: Recent research advances* (pp. 5-30). Oxford, UK: Oxford University Press.

Parkinson, B., Totterdell, P., Briner, R. B., & Reynolds, S. (1996). *Changing moods: The psychology of mood and mood regulation*. New York: Addison Wesley Longman.

Parr, L. A., Preuschoft, S., & de Waal, F. B. M. (2002). Afterword: Research on facial emotion in chimpanzees, 75 years since Kohts. In F. B. M. de Waal (Ed.), *Infant chimpanzee and human child: A classic 1935 comparative study of ape emotions and intelligence. By N.N. Ladygina-Kohts.* (pp. 411-446). Oxford: Oxford University Press.

Pellegrini, A. D., & Smith, P. K. (1998). Physical activity play: The nature and function of a neglected aspect of play. *Child Development, 69*(3), 577-598.

Pellis, S. M., & Pellis, V. C. (1996). On knowing it's only play: The role of play signals in play fighting. *Aggression and Violent Behavior, 1*(3), 249-268.

Peterson, C. (2006). *A primer in positive psychology*. Oxford, UK: Oxford University Press.

Planalp, S. (1999). *Communicating emotion: Social, moral, and cultural processes.* Cambridge, UK: Cambridge University Press.

Plooij, F. X. (1978). Some basic traits of language in wild chimpanzees? In A. Lock (Ed.), *Action, gesture and symbol: The emergence of language* (pp. 111-131). New York: Academic Press.

Plooij, F. X. (1979). How wild chimpanzee babies trigger the onset of mother-infant play - and what the mother makes of it. In M. Bullowa (Ed.), *Before speech: The beginning of interpersonal communication* (pp. 223-243). Cambridge, UK: Cambridge University Press.

Plutchik, R. (1994). *The psychology and biology of emotion*. New York: Harper Collins.

Power, T. G. (2000). *Play and exploration in children and animals*. Mahwah, NJ: Lawrence Erlbaum.

Preuschoft, S. (1992). "Laughter" and "smile" in Barbary macaques, *Macaca sylvanus*. *Ethology, 91*, 220-236.

Preuschoft, S., & van Hooff, J. A. R. A. M. (1997). The social function of "smile" and "laughter": Variations across primate species and societies. In U. Seyerstrale & P. Molnar (Eds.), *Non-verbal communication: Where nature meets culture* (pp. 171-189). Mahwah, NJ: Lawrence Erlbaum.

Provine, R. R. (2000). *Laughter: A scientific investigation*. London, UK: Faber & Faber Ltd.

Ramsey, J. K., & McGrew, W. C. (2005). Object play in great apes: Studies in nature and captivity. In A. D. Pellegrini & P. K. Smith (Eds.), *The nature of play: Great apes and humans* (pp. 89-112). London: The Guilford Press.

Rozin, P., Taylor, C., Ross, L., Bennett, G., & Hejmadi, A. (2005). General and specific abilities to recognise negative emotions, especially disgust, as portrayed in the face and the body. *Cognition and Emotion, 19*, 397-412.

Rubenstein, J. L., & Howes, C. (1979). Caregiving and infant behaviour in day care and in homes. *Developmental Psychology, 15*(1), 1-24.

Rubin, K. H., Fein, G. G., & Vandenberg, B. (1983). Play. In P. H. Mussen (Series Ed.) & E. M. Hetherington (Vol. Ed.) (Eds.), *Handbook of child psychology 4th ed.: Vol 4. Socialization, personality, and social development* (pp. 693-774). New York: John Wiley and Sons.

Russell, J. A., Bachorowski, J.-A., & Fernandez-Dols, J.-M. (2003). Facial and vocal expressions of emotion. *Annual Review of Psychology, 54*, 329-349.

Saarni, C. (2000). The social context of emotional development. In M. Lewis & J. M. Haviland (Eds.), *Handbook of emotions* (2nd ed., pp. 306-322). New York: Guilford Press.

Savage, E., & Malick, C. (1977). Play and socio-sexual behaviour in a captive chimpanzee (Pan troglodytes) group. *Behaviour, 60*(1-2), 179-194.

Scarlett, W. G., Naudeau, S., Salonius-Pasternak, D., & Ponte, I. (2005). *Children's play*. Thousand Oaks, CA: Sage.

Scherer, K. R., Wallbott, H. G., Matsumoto, D., & Kudoh, T. (1988). Emotional experience in cultural context: A comparison between Europe, Japan, and the United States. In K. R. Scherer (Ed.), *Facets of emotions* (pp. 5-30). Hillsdale, NJ: Lawrence Erlbaum Associates.

Schutz, W. C. (1967). *Joy: Expanding human awareness*. New York: Grove Press.

Schwartzman, H. B. (1982). Play as a mode. *Behavioral and Brain Sciences, 5*, 168-169.

Scott, E., & Panksepp, J. (2003). Rough-and-tumble play in human children. *Aggressive Behavior, 29*, 539-551.

Shaver, P., Schwartz, J., Kirson, D., & O'Connor, C. (1987). Emotion knowledge: Further exploration of a prototype approach. *Journal of Personality and Social Psychology, 52*(6), 1061-1086.

Siegel, S., & Castellan, N. J. (1988). *Nonparametric Statistics for the Behavioral Sciences.* London: McGraw-Hill.

Smith, P. K. (1982). Does play matter? Functional and evolutionary aspects of animal and human play. *Behavioral and Brain Sciences, 5*, 139-184.

Soken, N. H., & Pick, A. D. (1992). Intermodal perception of happy and angry expressive behaviors by seven-month-old infants. *Child Development, 63*, 787-795.

Sroufe, L. A., & Wunsch, J. P. (1972). The development of laughter in the first year of life. *Child Development, 43*, 1326-1344.

Sutton-Smith, B. (1997). *The ambiguity of play*. Cambridge, MA: Harvard University Press.

Takeshita, H., Fragaszy, D., Mizuno, Y., Matsuzawa, T., Tomonaga, M., & Tanaka, M. (2005). Exploring by doing: How young chimpanzees discover surfaces through actions with objects. *Infant Behavior and Development, 28*, 316-328.

Takeshita, H., & Walraven, V. (1996). A comparative study of the variety and complexity of object manipulation in captive chimpanzees *(Pan trogloytes)* and bonobos *(Pan paniscus)*. *Primates, 37*, 423-441.

Thorsteinsson, K., & Bard, K. A. (2009). Coding infant chimpanzee facial expressions of joy. In E. Banninger-Huber & D. Peham (Eds.), *Current and future perspectives in facial expression research: Topics and methodological questions. Proceedings of the International Meeting at the Institute of Psychology* (pp. 54-61). University of Innsbruck, Austria: Innsbruck University Press.

Thorsteinsson, K., Ross, K., & Bard, K. A. (2008). Positive emotional expressions in chimpanzee infants [Abstract]. *Primate Eye: Primate Society of Great Britain, 96*, 37.

Tomasello, M., Call, J., Nagell, K., Olguin, R., & Carpenter, M. (1994). The learning and use of gestural signals by young chimpanzees: A trans-generational study. *Primates, 35*(2), 137-154.

Tomasello, M., George, B. L., Kruger, A. C., Jeffrey, M., Farrar, M. J., & A, E. (1985). The development of gestural communication in young chimpanzees. *Journal of Human Evolution, 14*(2), 175-186.

Tomasello, M., Gust, D., & Frost, G. T. (1989). A longitudinal investigation of gestural communication in young chimpanzees. *Primates, 30*(1), 35-50.

Tomkins, S. S. (2008). *Affect imagery consciousness: The complete edition* (Vol. I and II). New York: Springer.

van de Rijt-Plooij, H. H. C., & Plooij, F. X. (1987). Growing independence, conflict, and learning in mother-infant relations in free-ranging chimpanzees. *Behaviour, 101*(1-3), 1-86.

Van den Stock, J., Righart, R., & de Gelder, B. (2007). Body expressions influence recognition of emotions in the face and voice. *Emotion, 7*(3), 487-494.

van Hooff, J. A. R. A. M. (1972). A comparative approach to the phylogeny of laughter and smiling. In R. A. Hinde (Ed.), *Non-verbal communication* (pp. 209-241). Cambridge, UK: Cambridge University Press.

van Hooff, J. A. R. A. M. (1973). A structural analysis of the social behaviour of a semi-captive group of chimpanzees. In M. von Cranach & I. Vine (Eds.), *Social communication and movement: Studies of interaction and expression in man and chimpanzee*. London: Academic Press Inc. Ltd.

van Lawick-Goodall, J. (1968). The behaviour of free-living chimpanzees in the Gombe Stream Reserve. *Animal Behaviour Monographs, 1*(3), 161-311.

van Lawick-Goodall, J. (1972). A preliminary report on expressive movements and communication in the Gombe Stream chimpanzees. In P. Dolhinow (Ed.), *Primate Patterns* (pp. 25-84). New York: Holt, Rinehart and Winston, Inc.

Vettin, J., & Todt, D. (2005). Human laughter, social play, and play vocalizations of non-human primates: An evolutionary approach. *Behaviour, 142*, 217-240.

Vick, S.-J., Waller, B. M., Parr, L. A., Pasqualini, M. C. S., & Bard, K. A. (2007). A cross-species comparison of facial morphology and movement in humans and chimpanzees using the Facial Action Coding System (FACS). *Journal of Nonverbal Behavior, 31*, 1-20.

Wagner, H. (1997). Methods in the study of facial behavior. In J. A. Russell & J.-M. Fernandez-Dols (Eds.), *The psychology of facial expression* (pp. 31-54). Cambridge: Cambridge University Press.

Walker, A. S. (1982). Intermodal perception of expressive behaviors by human infants. *Journal of Experimental Child Psychology, 33*, 514-535.

Waller, B. M., & Dunbar, R. I. M. (2005). Differential behavioural effects of silent bared teeth display and relaxed open mouth display in chimpanzees *(Pan troglodytes)*. *Ethology, 111*, 129-142.

Weisfeld, G. E. (1993). The adaptive value of humor and laughter. *Ethology and Sociobiology, 14*, 141-169.

Wierzbicka, A. (1999). *Emotions across languages and cultures: Diversity and universals*. Cambridge, UK: Cambridge University Press.

Wolff, P. H. (1987). *The development of behavioral states and the expression of emotions in early infancy: New proposals for investigation*. Chicago: University of Chicago Press.